JUNE 1955

Power Engineering

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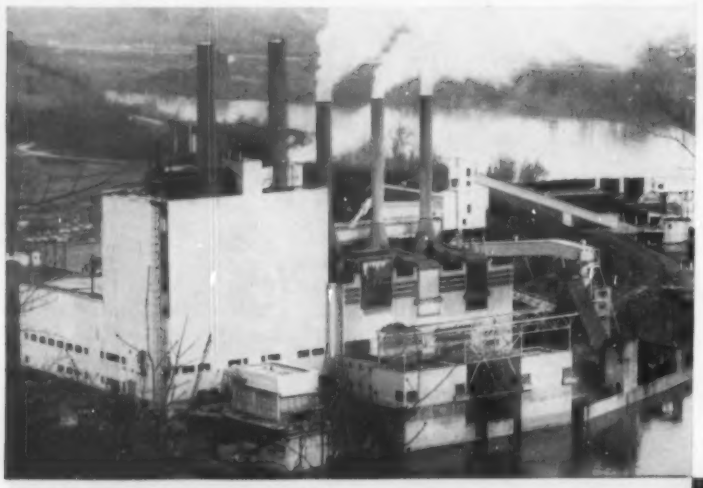
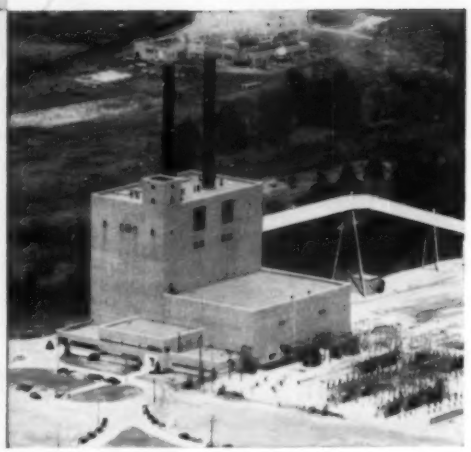


R. E. Burger Plant, Belmont County, Ohio
Present capacity: 270,000 KW
Scheduled capacity: 500,000 KW

Oh, I see

. . . they're using OIC Valves at Ohio Edison Company



Niles Plant at Niles, Ohio
Capacity: 212,000 KW

Postwar use of electricity has grown tremendously in the area served by the Ohio Edison System. New facilities added in the last 9 years have more than doubled total generating capacity. The Niles, Ohio, plant is completed, but expansion is still under way at the R. E. Burger plant.

Thousands of OIC Valves are used in these plants.

The OIC Long Line of Valves includes forged and cast steel, brass and iron valves. All are engineered and built to give long, trouble-free service. For a free copy of the OIC Catalog Digest listing these valves for quick reference, ask for Form 197.

OIC
FOUNDED 1883

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

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115 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

You can depend on Erie City for sound engineering

A NEW USE FOR STEAM *at* BREA CHEMICALS INC.

designed by **BREA CHEMICALS INC.**
constructed by **C. F. BRAUN & CO.**

Brea Chemicals, Inc. at Brea, California applies sound engineering to produce ammonia from air, water, and natural gas.

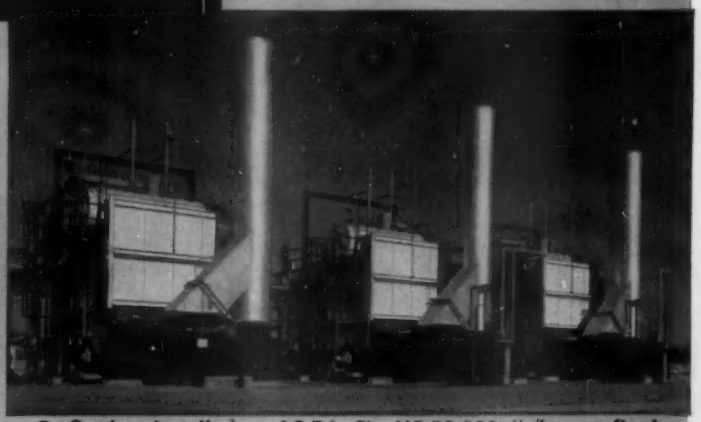
The air is washed clean of carbon dioxide with caustic; compressed, dried, and liquified. The liquid air is fractionated, and the overhead nitrogen product is one of the basic materials for ammonia synthesis.

Water is added to three Erie City VC Steam Generators and becomes steam. Part of this steam reacts with natural gas in a reforming furnace. The effluent gas contains hydrogen, oxides of carbon, and methane. The flue gases from the furnace are used as a source of waste heat to operate two Erie City VL steam generators. The steam from these generators augments plant steam requirements at low cost.

Carbon dioxide is removed from the reformed gas by scrubbing with a liquid amine solution, recovered, and processed to form dry ice. The carbon monoxide and methane are removed by scrubbing with liquid nitrogen. The overhead product from the nitrogen wash column is a mixture of hydrogen and nitrogen ready for the synthesis operation.

Ammonia from the Brea process provides the foundation for servicing the farmer with aqua ammonia, aqua ammonium phosphate, and ammonium sulfate, and in the near future—ammonium nitrate.

Erie City through the application of sound engineering in the design of its products, is proud of the part it plays in this new petrochemical industry.

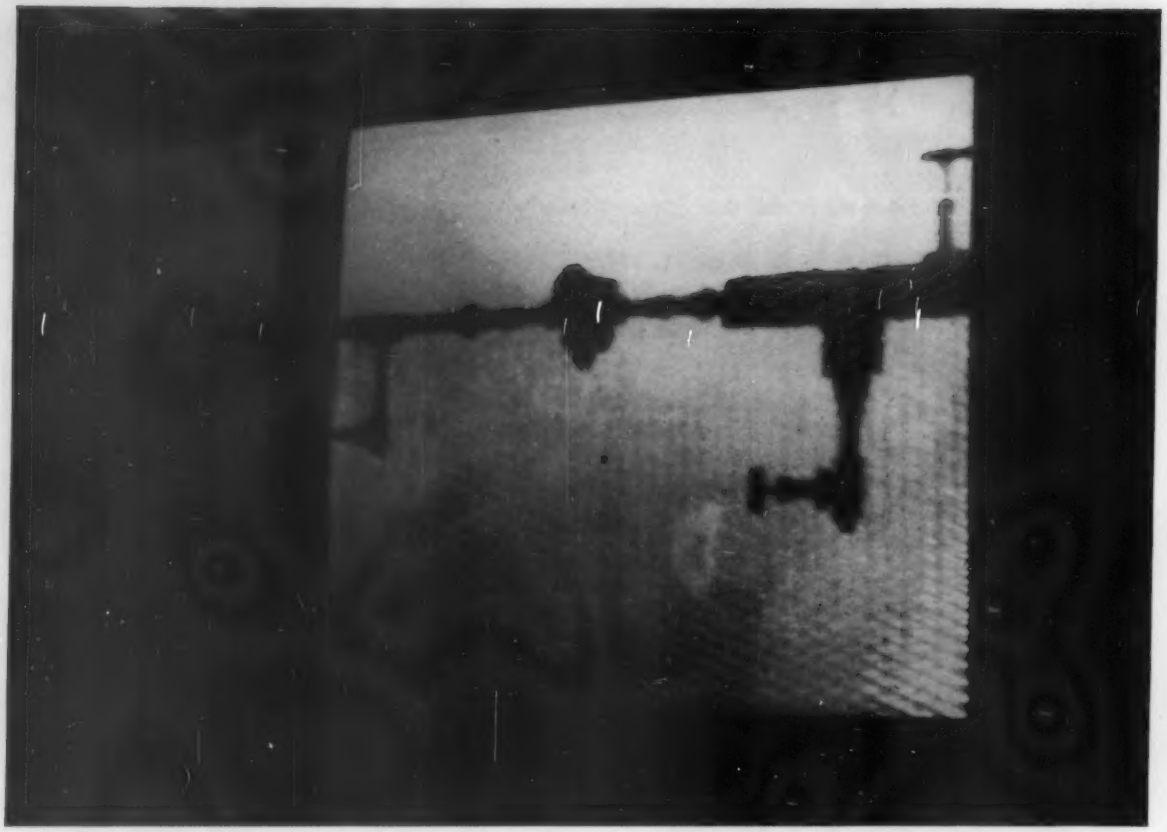


● Outdoor installation of 3 Erie City VC 50,000 #/hr. gas fired Steam Generators at Brea Chemicals, Inc.

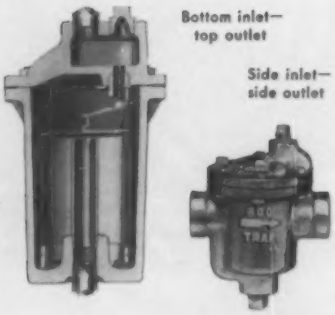
● Outdoor installation of 2 Erie City VL Waste Heat Boilers fired by flue gases from the Reform Furnaces shown above.

● Air view of the Brea Chemicals Inc. Ammonia Plant at Brea, Cal.

For more data circle 502 on Post Card



A Steam Trap Casts a Mighty Big Shadow



Corrosion- and wear-resistant materials; "frictionless" leverage; precision workmanship — add up to LOW MAINTENANCE.

Here are some of the results of retrapping equipment with Armstrongs:

Higher Temperatures. Milk dryer temperatures maintained 100° higher at Rochester Dairy Co., Rochester, Minn.

Faster Heat-up. Oven at pharmaceutical plant heats up 40 minutes sooner.

More Production. 30% more output from cooking kettles at National Cranberry Co., South Hanson, Mass.

Less Fuel. Coal consumption reduced 400 tons annually at A. J. Tower Company, Boston, Mass.

Less Maintenance. 25% less trap maintenance at Hooker Electrochemical Company, Tacoma, Wash.

BIG effects from little traps! And, the effects are multiplied by the number of traps in your plant until they grow to be a major influence upon operating efficiency. Your nearby Armstrong Representative can help you get maximum output from steam heated equipment at minimum cost. Call him, or write:

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810 Maple Street, Three Rivers, Michigan

Application Engineered

ARMSTRONG STEAM TRAPS

ASK FOR CATALOG . . .

The 44-page Steam Trap Book gives more examples of how good trapping helps users, tells how to get it. . . selection, installation, maintenance. Free on request — write or call today.

Armstrong traps also cataloged in Sweets and Chemical Engineering Catalog. S55

For more data circle 503 on Post Card

ENGINEERS' PREVIEW

CONTRACT just signed for the installation of a 200,000-kw steam electric generating unit, largest single unit ever built for the company, will help Niagara Mohawk Power Corp. provide a total of 3,100,000 kw with which to supply the expanding industrial and agricultural area Niagara Mohawk serves. Completion of the new record unit is scheduled for the Fall of 1957.

Stone & Webster Engineering Corp., which designed and constructed Niagara Mohawk's original installation at the C. R. Huntley station near Tonawanda, N. Y., in 1916–18, and constructed a number of extensions to the station in recent years, will start work immediately on the construction of the latest and largest single unit for the utility, at this station. When completed at a cost of approximately $30,000,000, the new 200,000-kw unit will give the Huntley station a total capability of 1,050,000 kw.

• • •

MANUFACTURE of the General Electric Co.'s 100th combustion gas turbine has been announced. Of these 100 units, 97 are now installed and operating in areas as widely separated as California and New England, Texas and Montana.

Units now in operation have totaled over 500,000 hr of service, or the equivalent of one machine operating night and day for over 55 years.

Of the 97 units now in operation, 40 are natural gas pipeline pumping units, 27 are used in locomotives, 10 are installed on a platform in Lake Maracaibo, Venezuela, to maintain pressure in oil fields, 17 are used for electric power generation by electric utility companies in the United States, two are used to generate electric power at an oil plant in Venezuela, and one is used in an oil refinery in the United States.

• • •

FIFTEEN engineers and executives of the Spanish electric power industry have been in the United States to study American electric power systems and related facilities.

The study, sponsored by the Foreign Operations Administration's technical exchange program, complements the phase of U. S. economic aid to Spain under which $12,500,000 has been earmarked to help increase production and distribution of electric power, particularly thermal electric power.

During the six-week program the two teams — one on hydroelectric and the other on thermal (steam) electric power — joined in studies in New York City, Schenectady, Buffalo, the Detroit area and Washington, D. C. The ten-man hydroelectric power team also visited in Bethlehem and York, Pa., Chattanooga, Atlanta and the Philadelphia area while the six members of the thermal electric power team made special visits in New York City, Chicago, Milwaukee, Barberton, O., and Pittsburgh and Reading, Pa.

• • •

INNOVATION in American power practice was disclosed in a recent announcement of the Dayton Power & Light Co., that it has placed a contract with Combustion Engineering, Inc., New York, for a C-E Sulzer Monotube Steam Generator. Although this is the second C-E Sulzer Unit to be ordered in this country, it will be the first of the once-through type to operate at a steam pressure in the sub-critical range and will be larger than any such unit elsewhere.

The previous unit, ordered last year

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

by Philadelphia Electric Co., is designed for the super-critical pressure of 6000 psig — the highest steam pressure adopted to date anywhere in the world. The steam temperature for this unit, 1200 F, also establishes a new world record. Only one other super-critical pressure boiler has thus far been ordered in America, and there are none installed abroad. The Dayton installation will be the first once-through boiler in this country for conventional pressure. The Dayton unit is to be installed at the Company's Frank M. Tait Station in Dayton, where it will serve a 125,000-kwt turbine-generator. It will supply steam at 1800 psig, primary steam temperature 1000 F, and reheat temperature 1000 F.

• • •

ON JUNE 13th through the 17th, 1955, the 73rd Annual Convention of the National Association of Power Engineers, Inc. is scheduled to meet at the Hotel Waldorf-Astoria, New York, N. Y. This will be the first convention held by this Society in New York City since 1890.

• • •

HILTON A. LEVONIAN has been appointed vice president in charge of consulting engineering of The Kuljian Corp, engineers and constructors, according to an announcement by Arthur H. Kuljian, vice president, engineering. With headquarters in the main office in Philadelphia, Mr. Levonian will cover the far-flung activities of his department both in the United States and in many foreign countries. A graduate of Drexel Institute, Mr. Levonian has been with The Kuljian Corporation since 1947, serving as design engineer on electrical projects for such clients as General Electric, Sun Oil, Florida Power Corp., Ehret Magnesia Co., and many others.

• • •

FOLLOWING the death of E. R. Little, president of the E. R. Little Company, consulting engineers of Detroit, last November, his associates in the company are carrying on the company's work under the name of E. R. Little Associates, Incorporated, Mechanical & Electrical Engineers. Winston T. Kellogg is now president, Homer H. Parker, vice president and Duncan Black, treasurer.

POWER ENGINEERING Wins 1954 Safety Award

ONCE AGAIN POWER ENGINEERING has been honored for its editorial contributions to the field by receiving the National Safety Councils' Public Interest Award for 1954, for its articles on power engineering safety.

Out of 30 specialized and technical magazines receiving this award, POWER ENGINEERING was the only magazine in the power field on which it was conferred. Our companion magazine *Plant Engineering* also received an award.

The power engineer must always be thinking of the safety of both his men and his equipment and his methods, both for prevention of accidents and for continuity of operation. He never forgets safety for an instant.

Fully aware of this, through close contacts with its 36,000 readers, POWER ENGINEERING has presented a continuing program of articles on specific phases of safety in power engineering work, many by outstanding power engineers and safety engineers. A bibliography of these articles is available on request to the Editor.

We are proud that we have been able to contribute to our field the information leading to the National Safety Councils' Award.

LETTERS TO THE EDITORS

More on Ash Fusion Characteristics

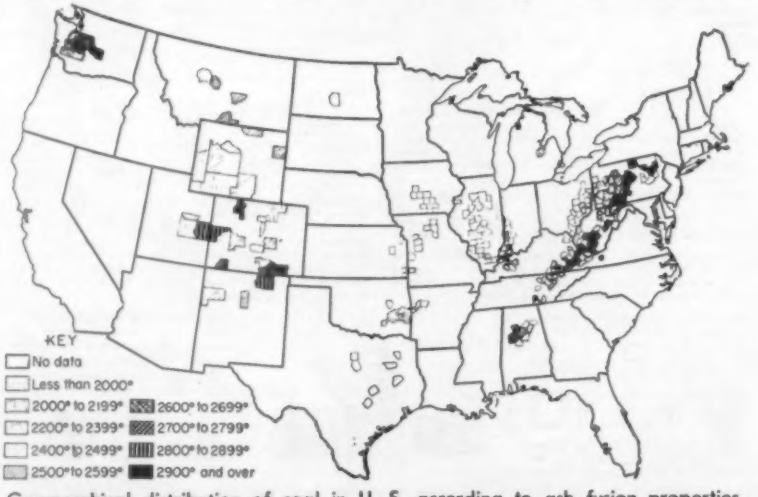
IN REVIEWING VARIOUS data on the properties of coal, I recently came across a map which indicates the nationwide distribution of coal according to its ash fusion temperature ranges. I believe this map can be valuable to procurement men and users of coal by serving as a guide in seeking to fit coals to their job. I personally watch for the source of each coal we receive as it is an indication of what its softening temperature and fusion characteristics will be.

The map, which appears on page 91, Fuels and Combustion Handbook, by Johnson and Auth, McGraw-Hill Book Co., is credited to William H. Young, "Sources of Coal and Types of Stokers and Burners Used by Electric Public Utility Power Plants," Brookings Institution, and was developed from analyses made by the U. S. Bureau of Mines.

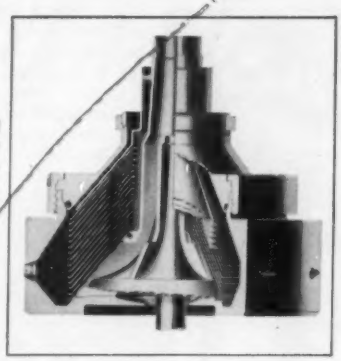
It is apparent from the map that the Appalachian coals, on the whole, have high fusion ash. Most Middle Western coals range from less than 2000 to 2199 F. Rocky Mountain coals vary widely between 2000 and 2900 F. The Washington State areas produce coals averaging above 2200 F in ash softening temperatures.

Knowledge of this geographical distribution can serve as "first aid" to the coal buyer in his selection of coal to suit the precise needs of his plant. He can only *start* from this map. — *F. M. Reiter, Dayton, Ohio*

Editor's Note: See Reiter's article, "How Sulfur Content of Coal Relates to Ash Fusion Characteristics," POWER ENGINEERING, May, 1955.

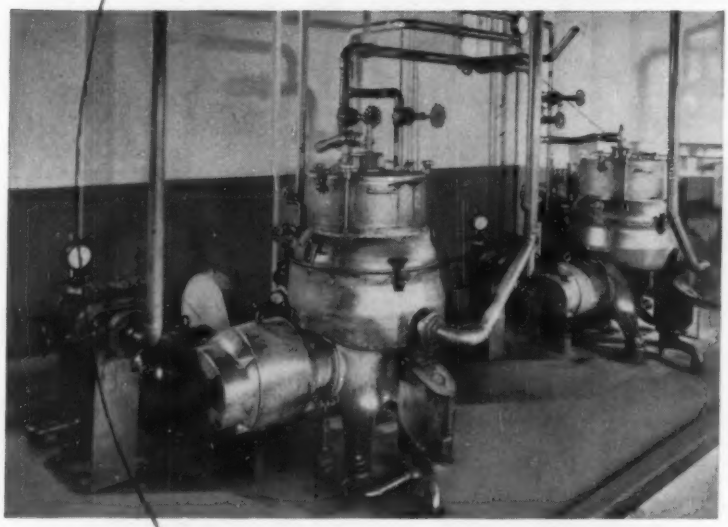


Geographical distribution of coal in U. S. according to ash fusion properties



De Laval "Nozzle-Matic" Bowl —first to be used on heavy fuel—Automatically Discharges Solids.

IF YOU CAN PUMP IT,
WE CAN PURIFY IT...CONTINUOUSLY!



Right now De Laval "Nozzle-Matic" Heavy Oil Purifiers are giving operators of large diesel plants all the savings inherent in low-cost residuals by successfully handling oils with viscosities up to 6000 SSU at 100°F.

Equally important, the De Laval "Nozzle-Matic" not only purifies maximum viscosity fuel at 600 gallons per hour . . . but purifies *continuously—regardless of the amount of solids present in the fuel!*

Requires practically no attention . . . only the most infrequent shut-downs for cleaning . . . assures maximum ash removal with continuous discharge of separated solids.

Results: Greatest fuel economy . . . lowest maintenance costs.

Get complete details . . . now!

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heavy oil purifiers

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For more data circle 504 on Post Card

HERE'S WHAT THEY TELL US

WE ENJOYED HEARING from C. M. Hardin of Chicago, who wrote:

> I hand you herewith the two postcards (saving you the 4¢ postage) covering the two photographs taken of Yours Truly with the other gentlemen in each case. Your sending me the two pictures will be indeed appreciated.
>
> May I compliment you nice people on your very outstanding and splendid participation in the Annual Chicago American Power Conference.

Thank you Mr. Hardin, regarding said postage . . . Seriously, it was very good of you to write.

R. L. SUTHERLAND, Truax-Traer Coal Company, sent along some interesting data with his note. He said:

> Referring to the article, $140 Preheater Eases Combustion Air Problem on page 96, April issue of POWER ENGINEERING, you might be interested in the attached reprint copy of a paper published in the March 1932 issue of the Western Canada Coal Review.
>
> Jacketed breechings to reclaim heat from stack gases without the installation of an induced draft fan have been in use in the Northwest for the past 25 years.

Editor Kramer remembered other operations and replied:

> Thank you very much for sending us the reprint of the article by Mr. Enman describing the Steam Plant at the Regina Railway Terminal at Regina, Saskatchewan and, in particular, for calling our attention to the use of jacketed breechings to reclaim waste heat from the stack gases.
>
> Some years ago, I saw a small homemade installation of a similar nature in a small paper mill up in Milwaukee. Here, too, the operator had built a housing around the base of his stack and partially around the breeching, and he reclaimed some waste heat in this manner.
>
> I am sure, as you say, the idea is not new by any means. Indeed, as I recall from my early days in the Navy, we had the Howden forced-draft system on some of the destroyers, way back in 1917 and 1918. This used an air heater of sorts, and in general the idea was the same.

Executive Editor Earle adds that there are references in old textbooks to an elementary air preheater, using the same principle that Mr. Stratton used, installed by Howden way back in the 90's on some boilers in a textile mill in Massachusetts.

In any case, regardless of the antiquity of the idea, it solved Mr. Stratton's problem at very low cost. A modern air preheater certainly would do better, but when you can't get the money for one, you do the best you can with what you can get.

"Besides having a flaw in your cooling system, I also see that you have a faulty belt guard."

S. PETTIGREW, Pacific Indemnity Company, requested 50 copies of the article on Toronto's turbine explosions, page 51, March 1955.

W. E. Trumpler of Pennsylvania who took exception to the article, wrote:

> Your Title "Did Brittle Fracture Cause Toronto Turbine Explosions?" interested me considerably. When I finished Norman Jones' summary I was disappointed. The two most important elements involved in any fracture are *Stress* and *Ductility*. Nothing was said about these. General discussion of the type given is just as useless to an engineer as would be scenery without a play to the theater.
>
> The point is that brittle failures involve the capacity of metal to flow in a ductile manner which relieves the effect of small stress concentrations. Also the real matter of interest is to indicate what cyclic stresses are obtained in operation compared to the endurance strength.
>
> In an engineering magazine let us not dodge the use of meaningful engineering terms and concepts.

Associate Editor Jones answered:

> I was naturally interested in your comments but I must admit I found them puzzling. You say I did not say anything about stress. Yet the article describes the five factors that probably weakened the end-bells, and each one concerns stress: 1. The end-bells were made of non-magnetic material which precluded heat treatment and made residual stress unavoidable; 2. The thickness of the end-bells made for more residual stress; 3. Cyclic loading caused fluctuating stresses; 4. Ventilating holes built in the end-bells weaken their ability to withstand the fluctuating stresses; and 5. Not drilling certain holes at the exciter end of the machines caused extra stresses around existing holes.
>
> You have probably forgotten more about metallurgy than I will ever know but I understand ductility to mean the ability of the metal crystals to flow under stress and so relieve a stress concentration.
>
> I also understand that the type of material of which these end-bells were made was such that the metal did not deform under stress and so the cold-working such as drilling holes caused stresses to build up in the crystals surrounding the holes and these could not be relieved by heat treatment. Though the actual word "ductility" was not used, the whole question of residual stress and cold-working cover the same subject.
>
> However, this is all by the way, since we clearly stated in the article, I was merely summarizing the paper delivered by Sir Claude Gibb, and since his paper itself was a summary of the large, complete report, my article was merely a summary of a summary. All my article could hope to do was give engineers a rough idea of the cause and let them know that a complete and detailed report would be available.
>
> I think your last paragraph was uncalled for. In trying to present information as simply and clearly as possible, we are not "dodging" the use of engineering terms. There is no merit in using long words where short ones will do as well or better.

We appreciate Mr. Trumpler's interest, while disputing his comment.

FREDERICK B. MORSE of Indiana who attended the American Power Conference in Chicago, said:

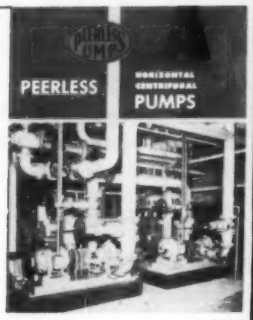
> I enjoyed visiting with some of your staff during the American Power Conference and have had time to look over the March issue of POWER ENGINEERING in detail.
>
> Your magazine strikes me as having good balance of feature articles and informative departments. I note that your advertisers are leaders in their respective fields.
>
> I would appreciate being on your mailing list so that I might have your excellent magazine regularly.

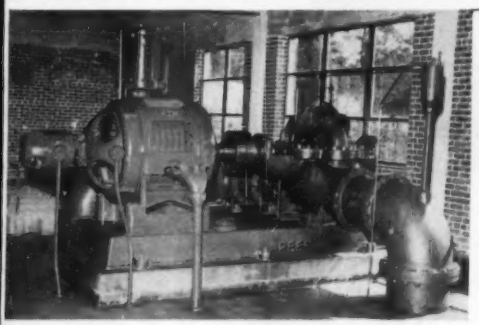
We thank you too, Mr. Morse. We're trying hard to keep our magazine on the beam for you.

look AT THE PUMPING PROBLEM *two ways*

VERTICAL

Ho Rizontal





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In the picture at the top above, a concentrated solution of sulphuric acid and aluminum sulfate is being pumped by Peerless vertical industrial service pumps. To find out all about them request Peerless Bulletin No. B-505.

The Peerless horizontal type A pump shown just above, is one of three that supplies plant water for a textile mill. To find out all about them request Peerless Bulletin B-1300 and B-1350.

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Body Improvements—flanged connections and expansion bends eliminate stuffing boxes and *prevent distortion*—separated design in four-glass inserts permit freedom for expansion—stainless steel facing for gasket recess provides corrosion proof surface for the higher pressures—close machining tolerances insure top quality.

Improved Gaskets and Mica—"Frelon" gaskets are coated with a special compound to prevent sticking at disassembly—wire inserts for the higher pressures give "Frelon" gaskets greater strength—thicker mica for the higher pressure gages.

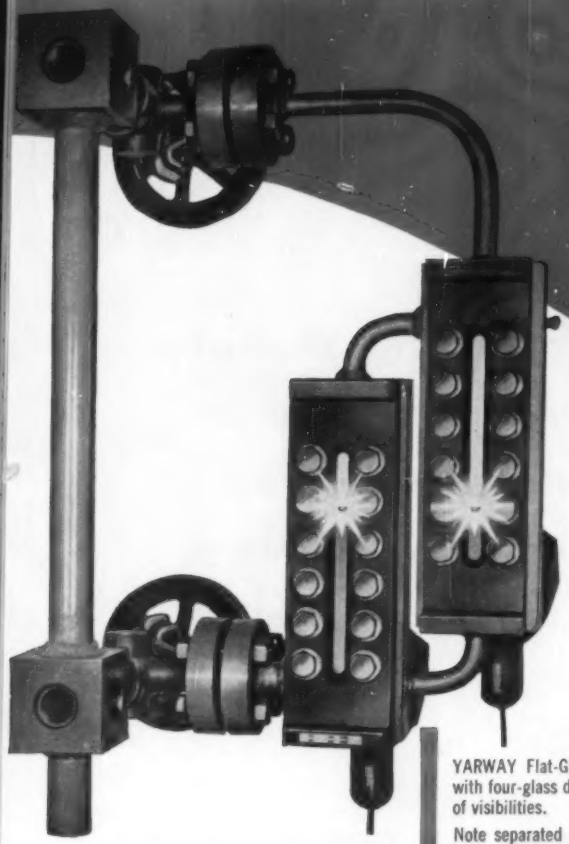
"Floating Assembly" Covers—improved capscrews have wider shoulders at face of body—improved spring cones reduce spring cone stresses.

Better Valves—YARWAY Welbond gage valves have integral stellite seats and stainless steel stems—Welbond water column shut-off valves have lock-open device.

YARWAY Gages are the "gages to see" on all new boiler units or replacements in high-pressure installations.

Write now for new YARWAY Bulletin WG-1812.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



YARWAY Flat-Glass Water Gage Assembly with four-glass double insert for long ranges of visibilities.

Note separated design, interconnecting expansion loops, flanged connections (1½" tie-bar-type circulating water column) and Type "M" Illuminators that make meniscus at water level "shine like a star".

YARWAY Single Insert type gage for medium range of visibilities. Note expansion loop and flanged connections. YARWAY Welbond Gage Valves assure highest dependability in high-pressure service.

Close-up of YARWAY Type "M" Illuminators on above 4-glass insert assembly. The blue-white illumination is visible for distances up to 125 ft. and is especially effective in penetrating deposits on gage glasses, dust particles in the air and extraneous light.

YARWAY

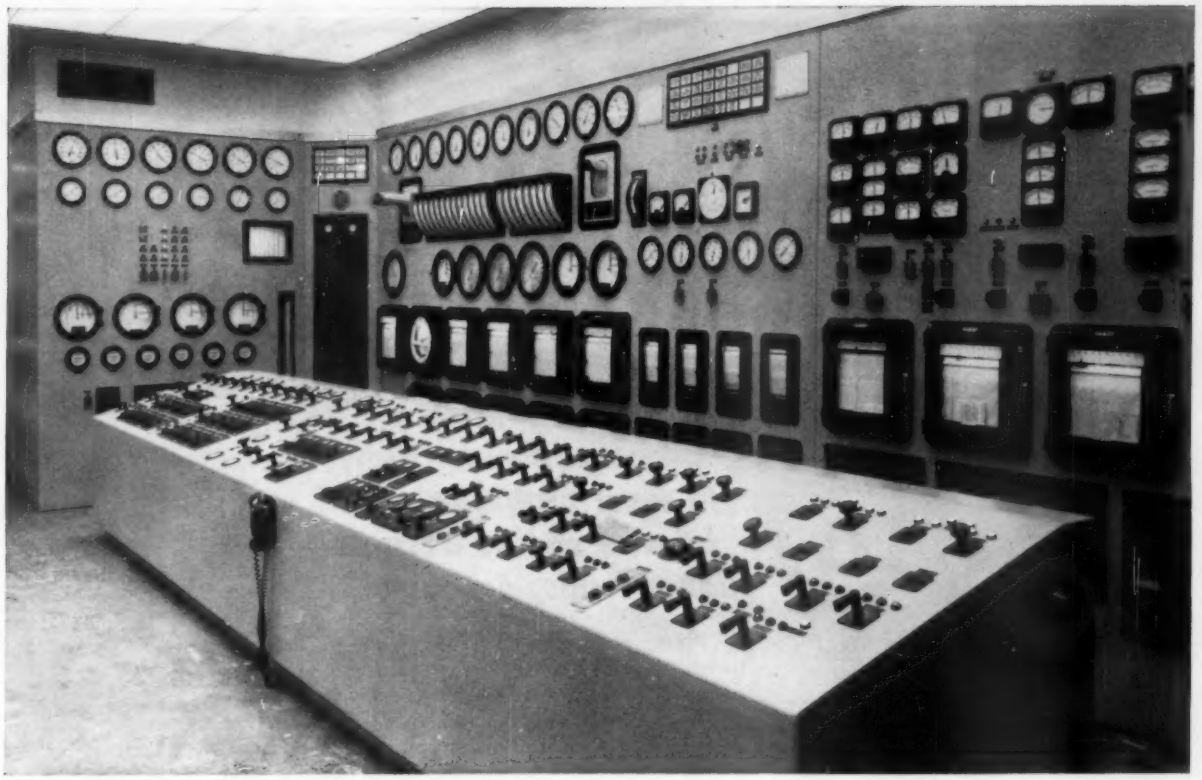
water columns and gages

Operating Boilers Electronically at Alabama Power Company's NEW BARRY PLANT

"On the line" since early 1954, the new Barry Steam Plant near Mobile, Alabama adds 250,000 kw to Alabama Power Company's expanding system. Plans provide for the possible enlargement of the plant to 1,000,000 kw capacity.

REPUBLIC

REPUBLIC FLOW METERS CO.



Centralized controls for station service switching, turbines, generators and boilers are in this room. Republic sub-panels on the bench board provide for either automatic or manual control of the boilers.

Automatic Combustion Controls

At the new Barry Steam Plant, two 900,000 lbs. per hour pulverized coal fired boilers operating at 1875 psi and 1000°F. are controlled by a Republic Electronic Master Combustion Control System.

Electronic impulses control pneumatically operated fuel, draft, and feedwater regulators on the boilers. Master control signals are transmitted practically instantaneously, permitting fast control response and close boiler control.

To ensure that both final firing rate and air flow will rapidly and accurately follow changes in steam load, the control system normally follows a dual element master control. This master controls the boiler auxiliaries from a rapid and proportional steam flow function together with a stabilized steam pressure function. Such a system combines the features of derivative control with automatic correction for fuel variation in such a manner that the effects of load swings are minimized almost to the vanishing point. Other control problems such as feedwater control and steam temperature control are simplified by the coordination of boiler auxiliary functions due to this system of combustion control.

Republic boiler feedwater is controlled automatically by a three-element feedwater control. To prevent heat damage to feedwater pumps during low flows, a Republic pump by-pass system has been installed. It automatically maintains a minimum flow of 125 gpm through each pump (two pumps per boiler) returning by-passed water to the deaerating heater storage tank.

Final efficiency tests recently completed at the Barry plant indicate the expected plant heat rate has been fully realized. There are Republic Automatic Combustion Control Systems — electronic or pneumatic — for all sizes and types of boilers, all methods of fuel firing and for any arrangement of draft equipment. For full details, write today.

2240 Diversey Parkway • Chicago 47, Illinois

For more data circle 50 on Post Card

NEW STANODIESEL OIL M

A new stationary industrial engine lubricant developed specifically to meet problems posed by new engine designs, higher loads, economy fuels

New STANODIESEL Oil M meets—and with plenty to spare—the performance requirements imposed on diesel lubricants by new engine designs, higher loads and the use of economy fuels. It meets these requirements because, first of all, it is an oil refined from the finest quality base stocks. It thus has superior stability. Then additives exclusive with STANODIESEL Oil M have been blended with these base stocks. The additives do these things:

1	**INHIBIT OXIDATION.** Prevent unwanted increases in oil viscosity. Prevent corrosion of bearings.
2	**PROVIDE DETERGENT-DISPERSANT ACTION.** Keep crankcase, pistons, cylinder walls and other parts clean. Keep contaminants in suspension, prevent redeposit.
3	**PROVIDE ANTI-FOAM ACTION.** Foaming tendencies of oil are controlled. Oil is suitable for use in hydraulic governors.
4	**INCREASE LUBRICITY.** Wetting agent increases oil's ability to reach and maintain a film on highly stressed parts.

STANODIESEL Oil M is a "Mil" type oil.

Your next move? Find out how STANODIESEL Oil M can serve you. In the Midwest call your nearby Standard Oil lubrication specialist. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANODIESEL OIL M
Does these things for your engine

1. Lessens engine deposits, ring and cylinder wear.
2. Lessens spark plug fouling.
3. Lessens fuel injector and pump sticking resulting from engine deposits.

STANDARD

STANDARD OIL COMPANY (Indiana)

HALL LABORATORIES, INC.—A SUBSIDIARY OF HAGAN CORPORATION, PITTSBURGH, PENNSYLVANIA

Hall Industrial Water Report

VOLUME 3 JUNE 1955 NUMBER 3

It Takes a Lot of Water Conditioning To Manufacture Textiles

Wizardry in the research laboratories has created a new world of fabrics, but the finished cloth is still a product of the operating engineers' know-how. And they have to use water to put their know-how to work. A ton of rayon, for example, requires about 830 tons of water in its manufacture, while about 160 tons of water are needed to produce one ton of finished wool cloth.

That's why Hall Laboratories, as water engineering consultant, plays such a vital role in the manufacture of textiles.

High Water, Low Water

Variable flow in the river supply helped show the need for competent water management in a southern acetate rayon plant.

During one spring flood, plant operators battled for 48 hours to keep excessive solids down in the high-pressure boilers. Turbidity, silica and suspended material in the softener effluent kept climbing in spite of increased chemical feed and boiler water silica concentration rose to high levels in spite of higher blowdown.

At the height of the flood, the utilities engineer secured water samples throughout the system for study by Hall. Dissolved silica in the flood water was found to be low, but much of the suspended material was quartz. Analysis of the other samples showed that more and more of this crystalline silica had dissolved as the temperature and pH of the water increased in the softener and boilers.

With the help of Hall field engineer W. J. Reese plant personnel improved softener operation and set up procedures which would enable them to better handle the next flood.

Six months after the flood came a drought and a new problem. Because of the high solids dissolved in the river water, boiler water concentrations quickly became high enough to cause carryover. Working with the plant personnel, Reese was able to bring operations back to normal.

Now more precise control all through the water cycle guards against future critical periods.

Water Detectives Reduce Problem to Grease Spot

Rejection of cloth, valued by the manufacturer at $75.00 a yard, represented a serious loss to a woolen mill in the Great Lakes area. Brown stains were spotting the cloth in the last step of the finishing process where the wool was rolled on a perforated drum through which hot water was circulated to "crab" or set the fibers of the material.

Because the staining was first believed to be iron carried into the hot water lines by iron-fixing bacteria originating in the well water, the plant was considering the expenditure of several thousand dollars for the installation of equipment at each of three wells to kill off the "bugs." When Hall staff engineer H. A. Reda was called in to investigate the problem, he enlisted the aid of E. T. Laurin, Hall headquarters expert on textiles and textile processing. The combined work of Reda at the plant and Laurin in his lab brought out the fact that the "iron deposits" on the cloth were not iron at all but wool grease. This was being loosened from the cloth itself by the heat of the recirculated process water and was then redeposited even though the recirculated hot water passed through filter cloth. After the condition was recognized, more frequent changing of filter cloth minimized the difficulty.

In the course of the investigation, Reda uncovered other conditions which could lead to trouble. Recommendations were made to control corrosion in the softened hot water system with Calgon® and to set up proper water conditions in the boilers.

* * *

Textile manufacturing today demands the services of many specialists. The remarkable textiles available now would be non-existent without expert control of each production step. Hall Laboratories has kept pace with each development in textile technology, so that the industry could have full control of its most important raw material . . . water.

Supercritical Conditions Pose New Problems

Will there be new problems when water is used in the supercritical range for generation of power at 5000 psi and 1200 F? In a paper presented on April 4 at the Diamond Jubilee Mechanical Engineering Conference of the American Society of Mechanical Engineers, Dr. Everett P. Partridge, Director of Hall Laboratories, Inc., points out what may happen as a result of the increased solvent power of water as pressure and temperature go up. A limited number of multilith preprints are available on request.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

AN IMPORTANT MESSAGE CONCERNING...

A Basic Advance In Motor Insulation

ELECTRIC motor and generator insulation has come in for its share of announcements of "new" and "revolutionary" developments. But in spite of these announcements, inherent shortcomings of conventional insulation have remained.

There has been little basic improvement in motor insulating systems . . . UNTIL NOW.

Allis-Chalmers, working with engineers and scientists of Dow Corning Corporation, has developed *Silco-Flex* motor insulation . . . truly new in concept . . . truly new in effectiveness.

The *Silco-Flex* insulation system employs a pure silicone rubber combined with specially developed application techniques to produce an insulation unmatched by any other in use today. Outstanding improvements are shown in all these important characteristics:

Homogeneity — The complete *Silco-Flex* coil insulation is vulcanized into a single piece with no joints, voids or splices which can develop into breaks in the insulation. Even the best of the new conventional insulations combine several dissimilar materials which are held together by binders.

Heat Resistance— The excellent dielectric and mechanical properties in silicone rubber do not change significantly with aging at high temperatures over long periods of time.

Moisture Resistance—Completely sealed, *Silco-Flex* insulated coils are the most moisture-resistant coils ever produced.

Chemical Inertness — *Silco-Flex* insulation has outstanding resistance to most atmospheric contaminants, corona and weathering. It also withstands weak acids, alkalies and lubricants.

Flexibility and Resilience — *Silco-Flex* insulation remains flexible and resilient indefinitely under operating conditions. It is especially resistant to mechanical abuse and to the stresses brought about by overloading and rapid starting and stopping. It is also amazingly resistant to abrasion.

Heat Dissipation — Most electric insulators, unfortunately, are also heat insulators. *Silco-Flex* insulation, by comparison, is an excellent heat conductor and materially assists in removing heat from the coils.

What Are the Benefits?

The characteristics of this new insulation are so remarkable that complete reappraisal of motor application practices and motor performance is indicated.

In *all* applications, the chemical, mechanical and electrical properties of *Silco-Flex* insulation insure increased service reliability and longer life.

In addition, this new insulation system may reduce or eliminate the need for special motor enclosures. Atmospheres contaminated with cinders and fly ash, for instance, will have little effect on *Silco-Flex* insulated windings. Similarly, abrasive dusts in steel mills will not harm this insulation. Savings through the use of open, instead of totally-enclosed, frames will also be possible in chemical, paper, food and other industries where water or corrosive atmospheres are a problem.

What About Availability?

New *Silco-Flex* insulation is immediately available for all Class H form-wound coils and for Class A and B windings. operating under selected service conditions.

For complete information on SILCO-FLEX ***insulated motors, see your Allis-Chalmers representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.*** A-4664

Silco-Flex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

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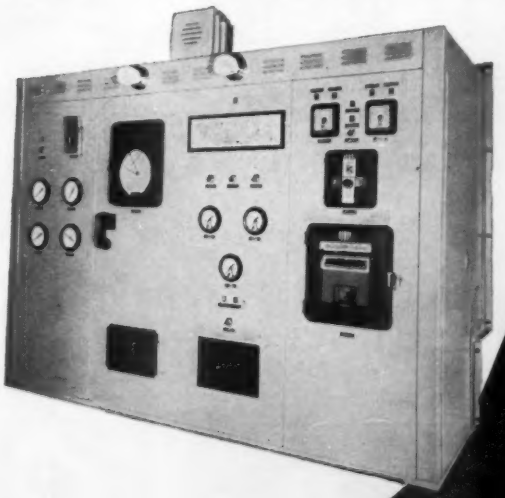
KIRK AND BLUM

CONTROL PANELS and DESKS
for INDUSTRIAL PLANTS and UTILITIES

For fabrication of control panels, desks and consoles, in any size, in any quantity . . . for any power plant requirement, call on Kirk & Blum.

Steel and alloy fabrication . . . sheets, plate and light structurals . . . has been a Kirk & Blum specialty for more than 48 years. Exceptional experience and complete facilities up to ½" in steel, stainless, aluminum, monel and other alloys.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication catalog. The Kirk & Blum Mfg. Co., 3230 Forrer St., Cincinnati 9, Ohio.



KIRK AND BLUM

SHEET METAL FABRICATION

For more data circle 511 on Post Card

How exhaust heat from a G-E Gas Turbine can cut your plant operating costs

NEW CYCLE CAN RESULT IN EFFICIENCY AS HIGH AS 70%

With more than 675,000 hours of successful commercial operation to their credit, General Electric gas turbines now offer power engineers this *new* formula for lowering processing costs:

Use the gas turbine to drive a generator of up to 16,000 kw or mechanical equipment up to 21,500 hp; pass the exhaust heat through a heat-recovery boiler to supply plant process steam up to 95,000 lbs. per hour. (If more process steam is required, use supplementary fuel firing to obtain up to 270,000 lbs. per hour.)

The resulting over-all efficiency may be as high as 70%!

Operating costs are low because gas turbines offer not only fuel savings resulting from high-cycle efficiency, but also economies in water, lubricating oil, maintenance, and manpower requirements. In addition, modified low-cost residual fuel oil can be burned in G-E gas turbines to provide even greater economy.

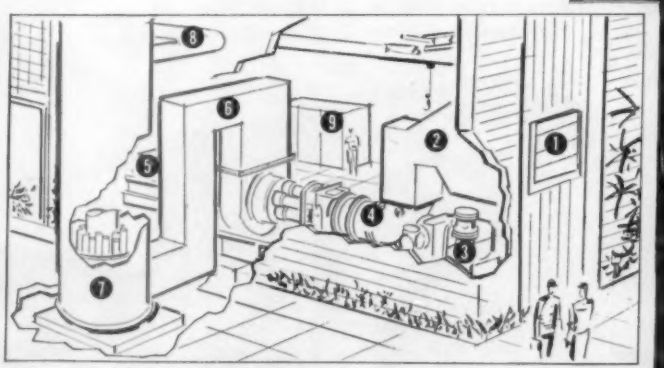
Initial costs are low too. Only small buildings and simple foundations are needed to install a G-E gas turbine; a new self-contained base houses most related auxiliary equipment.

Your company may well profit from using a G-E gas turbine, and General Electric will be happy to work out an economic study with you.

For more information contact your nearest G-E Apparatus Sales Office or write for Bulletin GEA-5516B. General Electric Company, Section 261-16, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC



TREMENDOUS SAVINGS in installed cost have been made possible by this new gas turbine base mounting, recently developed by G-E engineers. Serving as a rigid foundation, it also houses most

CHIEF COMPONENTS are: 1. Filter and/or air washer, 2. inlet duct, 3. starting unit device, 4. gas turbine, 5. gas compressor or driven equipment, 6. exhaust duct, 7. exhaust heat recovery

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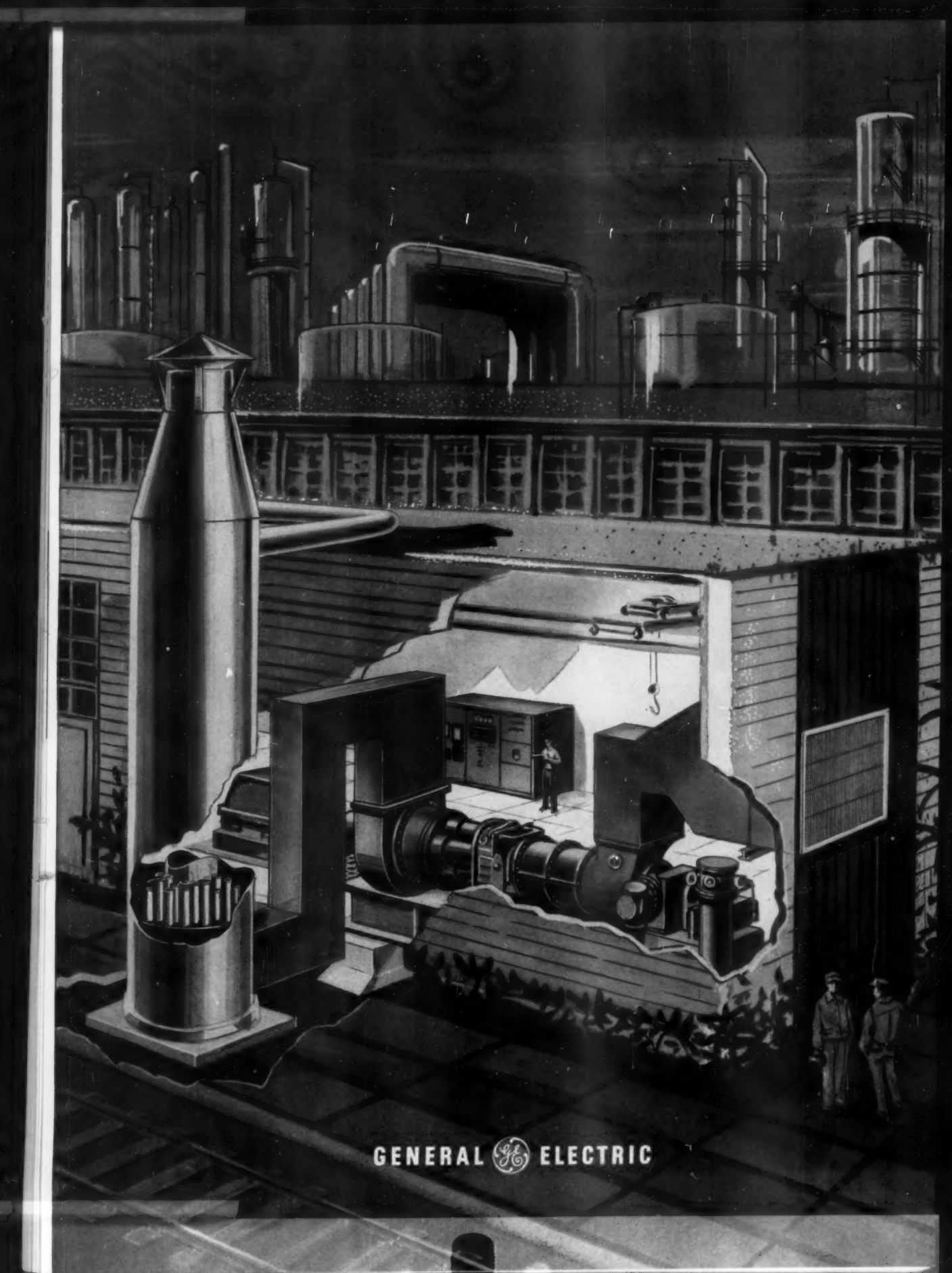

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CHIEF COMPONENTS are: 1. Filter and/or air washer, 2. inlet duct, 3. starting unit device, 4. gas turbine, 5. gas compressor or driven equipment, 6. exhaust duct, 7. exhaust heat recovery

New Conveyor Belt Combines Increased Strength With Extra Flexibility

Rugged Mainliner - Conveyking conveyor belt is engineered for tough jobs involving high tensions, high lifts and long center distances. It's ideal for conveying coal, ores and aggregates. It's steel-like in strength, practically stretchless, yet extremely flexible and troughs easily.

Mainliner belts have about twice the strength of ordinary cotton duck belts of the same gauge. They resist the destructive action of water, oil, weather and age. Why? Because these belts are made of multiple plies of strong duck with Nylon woven across the width and a new-process, high-strength cotton woven lengthwise, with skim coats between plies. They are available in any lengths, with any number of plies, in widths up to 72".

Like other heavy duty belts, these Mainliner Conveyking belts are custom made to meet particular requirements of individual jobs. They can be made with a cover tensile strength of 3500 to 4000 pounds average and a friction pull of 20 to 24 pounds average. They can also be made with a cover tensile strength of 2500 to 3000 pounds and a friction pull of 16 to 19 pounds. They are also available in oil-resistant Neoprene. All are mildew inhibited throughout. A breaker strip can be included in top cover, if specified.

We also manufacture a complete line of industrial rubber products: hose, belting, packing and moulded rubber of every construction for every need. *Through your Quaker and Quaker Pioneer distributor* our research and engineering services are always available to help you solve any industrial rubber problem. *Write for free folder and name of distributor.*

QUAKER RUBBER CORPORATION
Philadelphia 24, Pennsylvania

HKP
H. K. PORTER COMPANY INC. OF PITTSBURGH

QUAKER PIONEER RUBBER MILLS
San Francisco 7, California

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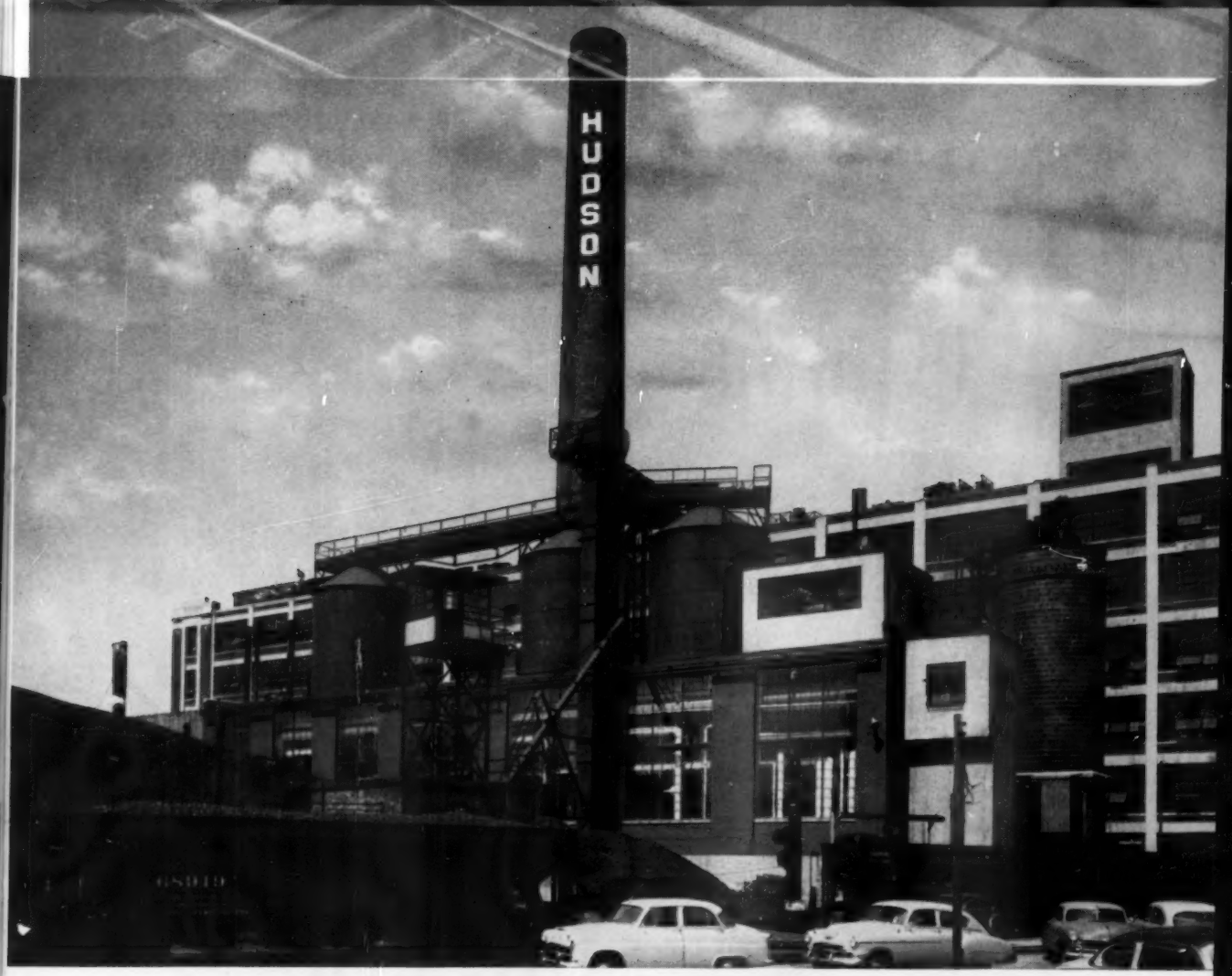
GENERAL ELECTRIC



Hudson saves $480,000 a year burning coal the modern way

A decision to improve its power service opened many possible courses of action to Hudson Motor Division of American Motors Corp. Based on findings of consultants Boddy, Benjamin and Woodhouse, Inc., Hudson decided to modernize completely its coal-burning, steam, electrical and compressed air equipment.

Today, steam at Hudson is supplied by three new boilers instead of ten old ones. Other new equipment includes a coal-handling system, automatic combustion controls and automatic ash disposal system. Manpower needs in the boiler area have been cut from 14 to 10 and in the compressor area from 8 to 6. With a reliable power supply, Hudson is protected from service interruptions. And the reduced cost of operation resulting from the new equipment will pay off the original investment in six years, leaving an annual saving of $480,000 thereafter!

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Why not talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars each year.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

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FIG. 16003—600-Pound Steel Pressure Seal Gate Valve.

Performance-- Value...

FIG. 6061 WE—600-Pound Stainless Steel Swing Check Valve.

. . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . .

FIG. 3003 WE—Steel Gate Valve for 300 Pounds W.S.P.

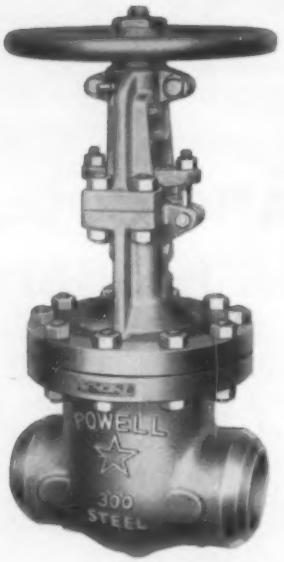

FIG. 1793—Iron Body, Bronze Mounted, Gate Valve For 125 Pounds W.P.

Powell Valves

You can depend on outstanding *performance* from every valve made by The Wm. Powell Company, for Powell Valves have a proven record of long life and dependable service.

And Powell Valves give you better *value!* They're precision made and incorporate many quality features—features that can save you money and give you lasting flow control.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our *COMPLETE quality line*, and help solve any flow control problem you may have.

The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year

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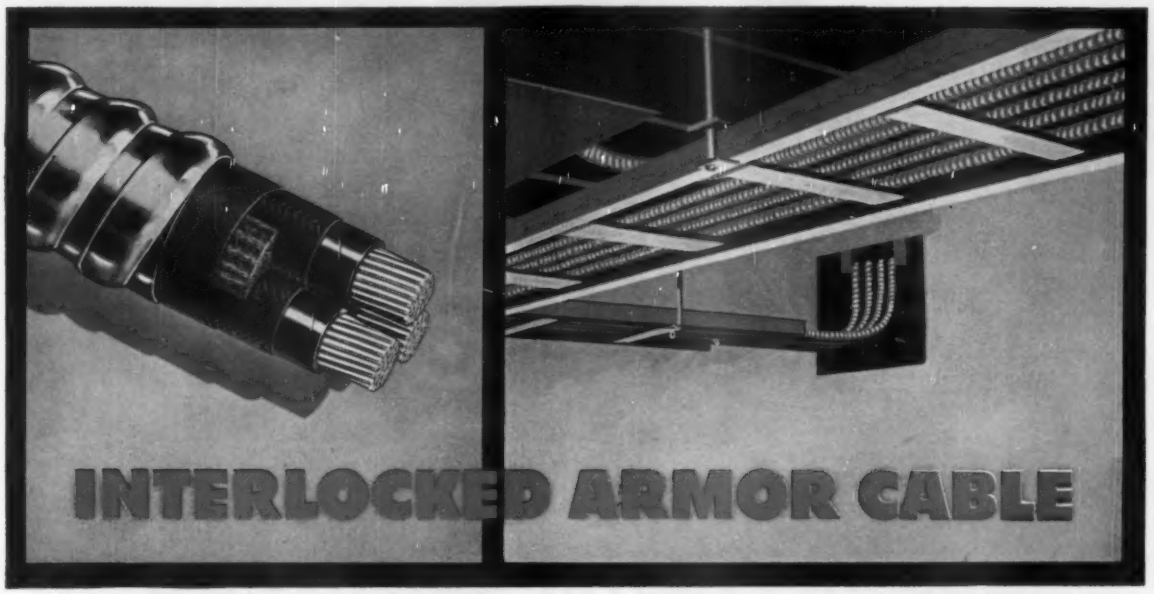
GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE



Where extraordinary mechanical protection is required, any type of cable can be armored. General Cable offers this complete range of interlocked armor types:

Armor: copper, aluminum, bronze and steel.
Insulation: varnished cambric, rubber and thermoplastic.

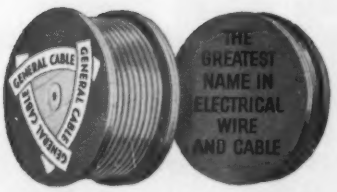
THE RESULT: a lightweight, flexible Interlocked Armor Cable that is ideal for wiring in close areas...under, down and around beams and pillars...where power needs vary...where plant layout presents space difficulties. Right angle bends, long runs and close quarter installations are easier to make and cost less than conventional cable and conduit.

To cut installation time and cost in new construction or old...Interlocked Armor Cable is used for primary or secondary feeders, and for connecting low-voltage plug-in bus and power utilization equipment.

From conductor to armor... General Cable offers you the ultimate in proven-in-use power and control cables...QUALITY that pays off in DEPENDABILITY, SAFETY, and EXTRA LONG LIFE.

Next time you are faced with a wiring problem that entails the need for mechanical protection ...look to General Cable for the simplest, most economical answer. And, remember, General Cable is the *only* manufacturer who can supply *all* your electrical wire and cable needs!

GENERAL CABLE
CORPORATION



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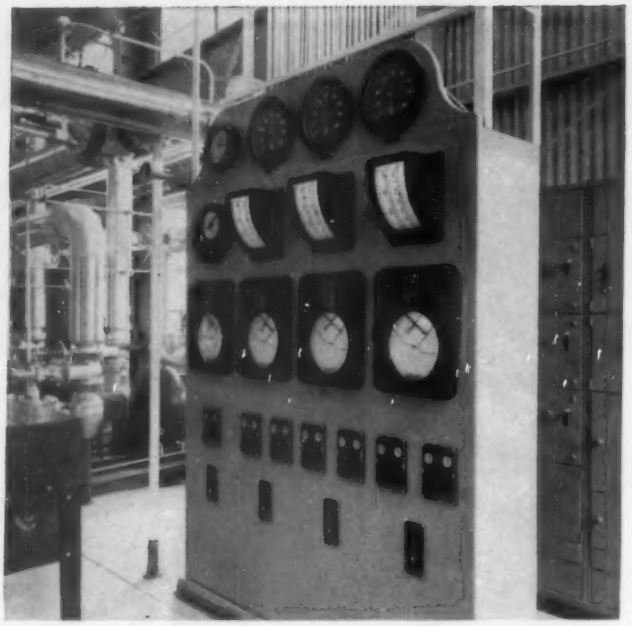

Bailey Boiler Control Panel for three 150,000 lb per hr, 400 psi, gas-fired boilers. Meter at left records total Steam Flow; the other three meters record Gas Flow—Air Flow and Flue Gas Temperature.

How to Control Steam Costs

★ Close regulation of fuel and air input is vital to a strict control of your steam cost. But that's not all. You'll need control of other factors, too. Your costs can be held down only by controlling all of the important operations in your steam plant. That's where you can be sure of help from Bailey Controls. Here's why they can do the job and do it right:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

2. Seasoned Engineering Experience

Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record. A-125-1

FORMULA
for Cutting Steam Costs

\+ Bailey Design
\+ Bailey Engineering
\+ Bailey Service
= Greater Savings per Fuel Dollar

BAILEY METER COMPANY
1040 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

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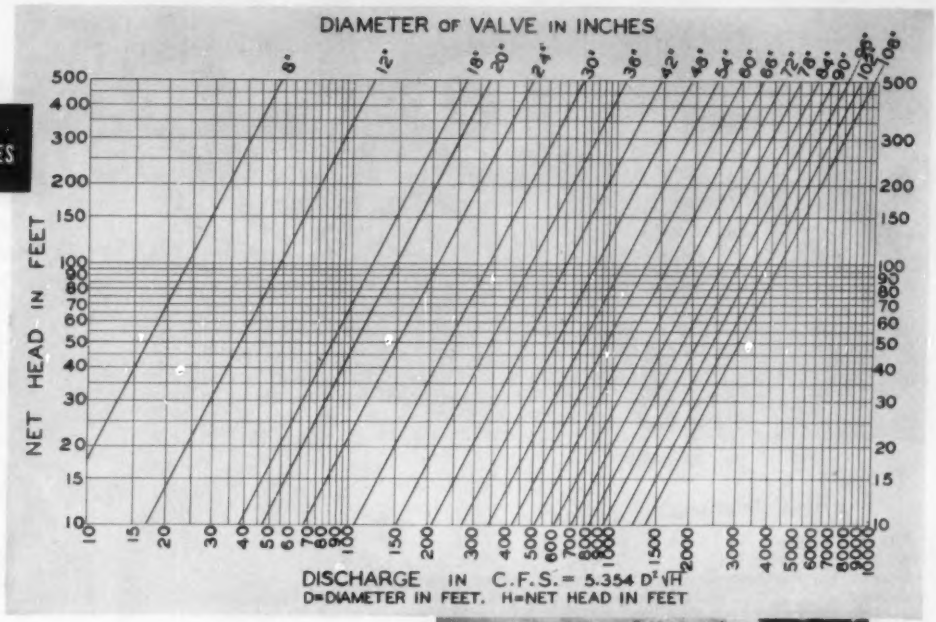
SMS
HOWELL-BUNGER VALVES



EASY REGULATION OF FREE DISCHARGE THROUGH HIGH TO LOW HEAD RANGE

SMS Howell-Bunger Valves provide easy regulation and control of water under free discharge. Tremendous amounts of energy can be dissipated with a minimum of erosion, cavitation and no vibration. Because of this valve's high discharge coefficient, pipe line or conduit size can be held to a minimum for economical construction.

The extremely rugged and simple design of the SMS Howell-Bunger Valve provides these essential features:

- Free discharge with safe energy dissipation
- Hydraulic balance without vibration
- High coefficient of discharge for an energy dissipating valve
- Minimum cavitation and maintenance
- Simplicity of operation
- Only one moving part in contact with stream flow
- Low initial cost
- Discharges into atmosphere or submerged.

S. Morgan Smith Company offers you more than 75 years experience with hydraulic equipment. The SMS name plate is your assurance that performance will equal or exceed specifications. For full information on Howell-Bunger Valves, turbines and related hydraulic equipment write the S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories

HYDRODYNAMICS

Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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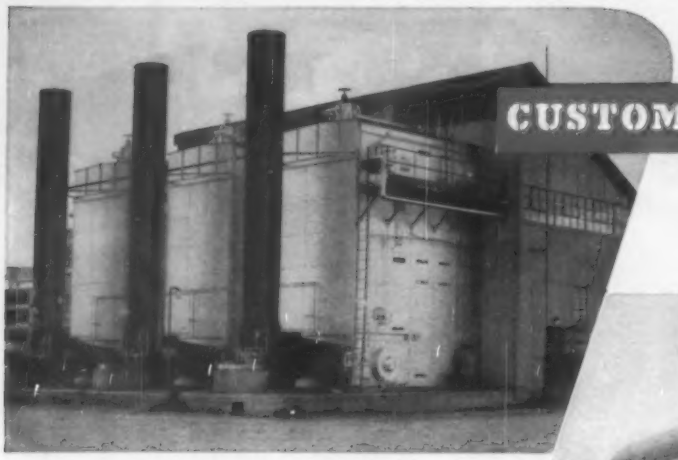
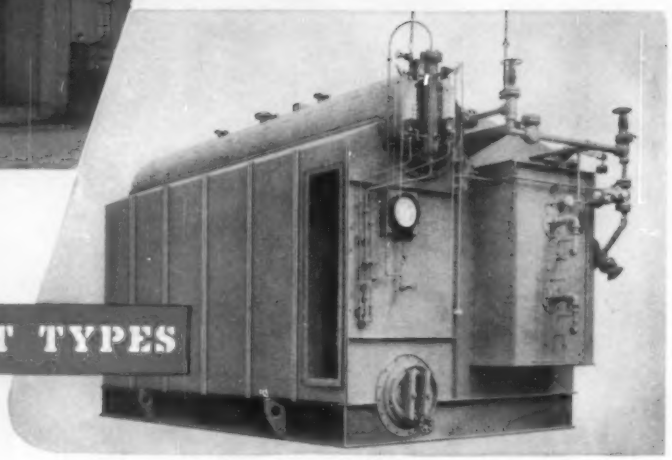


CUSTOM BUILT TYPES



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Types and Sizes for Every Power, Processing and Heating Requirement

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Vogt steam generators are designed to give maximum rating in minimum space, with high efficiency and low maintenance expense. They are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid or gaseous fuels burned singly or in combination.

Package units range from 10,000 to 30,000 pounds capacity and custom built units are obtainable in the larger capacities. Many installations in successful operation are proof of Vogt's ability to give effective help in the solution of steam generating problems. Bulletins may be had upon request.

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HELPFUL BULLETINS

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 117-118

PUMPS, COMPRESSORS

101 Power Plant Pumps — Twelve-pp Bulletin 107 gives engineering data on 19 models of two-stage regenerative pumps. Contains photos, diagrams showing principle of operation, data on mechanical seals available, installation dimensions. Tables cover performance of these pumps handling cold and hot water. Roy E. Roth Co.

102 Heavy Duty Pumps — Sixteen-pp Section *C* presents company's line of heavy duty rotary pumps. Covers Multi-Ring, Roto-Ring, unmounted, gear-drive, V-belt drive and other types, giving specifications, construction features and application suggestions. Also provided is an explanation of positive displacement principle utilized in the pumps; a selection table giving construction materials suitable for some 50 liquids; and an engineering section. Viking Pump Co.

103 Space Saving Pumps — Motor-pump Bulletin Form 7093-E, 24-pp, covers company's line of close-coupled Motor-pumps from ¼ to 75 hp sizes for delivery of 5 to 2800 gpm. The bulletin is designed to help in selecting the correct size and model. An index shows the basic classifications with their specifications. Advantages and design features are pointed out and each class of pump is explained and illustrated. Also illustrated are self-priming units and jet pumps. Modifications that can be made to standard units are shown. Cameron Pump Div., Ingersoll-Rand Co.

104 Sealless Pump Installation — This article tells how an installation of sealless centrifugal pumps solved leakage problems at an experimental station of a chemical manufacturer. Operating histories, installation details and specific operating advantages of these "canned rotor" pumps are given. Fluids handled there include Freon, Dowtherm and methyl alcohol. Chempump Corp.

105 Packaged Feed Systems — Chemical feed systems for general water treating requirements and for individual chemical processing needs are described in Bulletin LP-1254. Gives general specifications and diagrams some standard and special designs. Company's Phila-Feeder controlled capacity proportioning pump, incorporated in the systems, is described in detail. Philadelphia Pump and Machinery Co., Inc.

106 Low-Capacity Feeders — Bulletin 1910-3 describes Chlor-O-Mite low-capacity chemical feeders. Pictures the feeders and typical arrangements for constant rate, intermittent, flow proportional and hydraulic pulse feeding. Proportioneers, Inc.

107 Portable Compressors — Twelve-pp Catalog CG-9A pictures 40 models of company's portable type compressors. A quick reference chart shows the capacities, engine types, and mountings available. Illustrates such features as: replaceable cylinder sleeves, interchangeable valve parts, aircraft type compressor cylinders, heavy duty engines. Le Roi Div., Westinghouse Air Brake Co.

108 Gas-Engine-Driven Compressors — Form 3128-A, 44-pp, describes gas-engine-driven compressors in the 330 to 660 hp range. Bulletin covers all features of company's Type SVG four-cycle gas-engine-driven compressors. Important details are pointed out on cross-section drawings and a special cross-section traces paths of fuel, exhaust gases, lubricating oil, cooling water and the gas being compressed. Special sections cover SVG specifications, dimensions and data. The companion gas-engine power unit, the PSVG is also described. Ingersoll-Rand Co.

ELECTRICAL

109 Motor Buying Guide — Bulletin GEC-1026, 28-pp, features company's standard a-c fractional and integral horsepower motors in most general use. Included are general- and definite-purpose fhp motors, and fhp gear motors. A section on selection of integral horsepower motors covers horsepower requirements, enclosures, starting current limitations, speeds, motor types, and selection of fuses and circuit breakers. Descriptions and specifications include single-phase, polyphase, totally enclosed fan cooled, and gear-type integral horsepower motors. Photos, ratings, book prices, dimensions, weights, frame numbers, and standard modifications are included. General Electric Co.

110 Air Circuit Breakers — Sixteen-pp Manual 3-260 discusses selection and application of company's air circuit breakers for low voltage circuits. Includes sections on tripping device, as well as charts of time-current curves. Covers definitions of terms used in the application of low voltage breakers, method for determining short circuit currents. Also discusses selective and cascade arrangement of breakers, and gives portions of National Electrical Code. Federal Pacific Electric Co.

111 High Temp Cable — Bulletin 1088, 12 pp, presents Okotherm aluminum-sheathed cable for use up to 200 C. Details construction components of this cable, lists its special advantages, and some suggested applications. Booklet also discusses properties and features of the Okotherm insulation and the seamless aluminum sheath and gives procedure for simple terminations. Dimensions and data on fittings are included. The Okonite Co.

112 Conduit Facts — Twelve-pp Form 637 describes Sherarduct galvanized conduit. Explains and illustrates major advantages of this conduit — lifetime protection of wiring, easy workability, fast fishing of wires, and strength at threads and couplings. Gives size and weight data on conduit, couplings and elbows. National Electric Products Corp.

114 Cable Channel, Ladder — Bulletin 67-B describes standard cable channel and associated fittings which comprise a system of hot dip galvanized steel channels for the continuous support of electrical cable. A Bulletin 67-C covers standard cable ladder and associated fittings which comprise a system of lightweight ladder parts for the intermittent support of cable. Both bulletins are illustrated, provide full dimensional data. T. J. Cope, Inc.

COMMUNICATION

115 Power Line Carrier — Descriptive Bulletin 84–400, 24-pp, features company's Type FD power-line carrier equipment for voice communications. Describes improved receiver selectivity, operation from station batteries, filament current regulation, and accessibility of assemblies. Use of carrier for manual simplex, duplex and automatic simplex voice communications is told. Westinghouse Electric Corp.

116 Sound Powered Telephone Systems — Catalog 400-C, 6-pp, is a newly revised issue of company's catalog on sound powered telephone systems. Describes component parts, station components, method of operation; points out various applications. Optional accessories listed. United States Instrument Corp.

INSTRUMENTS AND CONTROLS

117 Industrial Instruments — Catalog 5002 is new 28-pp issue of company's composite catalog on industrial instruments and equipment. Pyrometers, potentiometers, thermometers, pressure gages, flow and liquid level meters, systems and components, panel boards and related instruments, transmitters motorized valve assemblies, switches and starters, many others. Fully illustrated, catalog gives features and suggested uses for the instruments, also references to detailed literature available. Industrial Div., Minneapolis-Honeywell Regulator Co.

118 Metering, Control System — Catalog B-36-A, 12 pp, presents company's Inductronic system for measurement and control. Gives technical information and application data on the basic d-c amplifying unit as well as on such companion models as multi-range amplifiers, sensitizing amplifiers, integrating fluxmeters, limit and knife-edge control units and Inductronic product resolvers. Weston Electrical Instrument Corp.

119 Pneumatic Indicating Controller — Twelve-pp Bulletin 5A-13 describes company's pneumatic indicating controller for process variables such as temperature, pressure, liquid level and humidity. New design features are explained, with emphasis on the longer, more readable indicating scale and simplified maintenance. Proportioning mechanism is diagrammed and typical applications

shown. Temperature and pressure measuring systems, filled thermal system available, temperature bulbs and accessories are discussed. The Foxboro Co.

120 For Flow Control — Twelve-pp Folder 231 introduces the Electro-Measurflo, an electrically-operated valve with flow volume control for medium flow volume application. Gives features of the valve, tells how it works. Technical information provided includes flow rate and electrical data. Hays Mfg. Co.

121 Liquid Level Gages — Bulletin L701, 26 pp, presents liquid level gages for indicating, recording, controlling, and telemetering. Well illustrated, shows float-, pressure-, differential pressure-, and bubbler-type gages in strip and round-chart models. New instruments featured include a time-liquid level program controller and miniature graphic-panel pneumatic transmission instruments. Engineering data on the choice of the proper bulb and instrument are given. The Bristol Co.

122 Indicating Controllers — Educational Bulletin 9, 16-pp, is concerned with application of automatic control equipment to solution of industrial process control problems. Discusses conventional millivoltmeter construction and its application to a control instrument. Also describes function of an oscillator circuit in a pyrometer controller, along with various control forms which can be developed from this type circuit. Includes information of value in determining proper control system. Wheelco Instruments Div., Barber-Colman Co.

123 Automatic Ratio Relay — Bulletin 8410 describes an automatic ratio relay which receives pneumatic input signals from two sources and transmits an output signal which is proportional to one of the inputs, with degree of proportionality determined by second input signal. This relay is useful in ratio control, cascade control and other uses in automatic control. Minneapolis-Honeywell Regulator Co.

MECHANICAL POWER TRANSMISSION

124 Improved Drive — Catalog PV-200-A, 36-pp, pictures and describes company's Poly-V Drive. Contains specifications on various sizes of stock sheaves and belts, complete engineering data for design of drives, along with tables of hundreds of practical stock drive combinations already worked out for convenient selection. Booklet is available to qualified power engineers. Browning Mfg. Co.

125 Handbook on Bearings — Bulletin H 54, a 52 pp revised size and capacity bearing handbook includes a section on company's new Sealed Guiderol bearing. An abridged edition of a large general catalog, this handbook also contains sections on Camrol, Multirol and Guiderol series of full-type roller bearings. Each section is illustrated and provides dimensional and load capacity tables and mounting details. Also, there are tables on bearing life factors, speed factors, interchangeability. McGill Mfg. Co., Inc.

COAL AND ASH HANDLING

126 Ash Handling System — Data Sheet Za covers the application of company's steam jet pneumatic ash handling systems to small steam boiler plants. Describes essential elements of these systems — bottom ash hoppers, ash gates, fly ash hoppers, material handling values, transport piping, steam jet exhausters, steam condensers and others — and explains their operation. Drawings show the conveying of boiler bottom ash and fly ash in a dry state to temporary storage silos for disposal. The Allen-Sherman-Hoff Co.

127 Spreader Stoker Firing — Illustrated Bulletin 18 outlines operation and design advantages of company's Rotograte stoker, stressing reduced coal cost and consistent efficiency at all loads. Other models for particular applications are also described. Detroit Stoker Co.

. . . Outstanding Among This Month's Catalogs

128 Electrical Relays — A complete line of basic type relays is described as to physical and electrical characteristics in 72-pp Catalog 11, and operating data and suggested applications are included. Illustrations of individual units, supported by dimensional drawings, offer a true impression of each relay. A-c and d-c relays include sensitive, heavy duty, versatile industrial, midget, telephone type, general purpose and others. A-N approved relays, sub-miniature relays, special relays, components and assemblies are shown. Book also provides definitions of engineering and electrical terms and laws. Guardian Electric Mfg. Co.

129 Control Devices — Catalog GEC-1260A, 68-pp, covers company's line of general purpose control devices, including a special section correlating by horsepower components for each type of motor control application. Contains photos, book prices, wiring diagrams, and dimensions on motor starters, contactors, relays, solenoids, switches, push buttons, and pilot devices. Also includes information comparing applications and merits of manual and magnetic control, and across-the-line and reduced-voltage control. The section on selection shows by enclosure, type and rating the exact components of motor control systems for each horsepower rating. General Electric Co.

130 Controls Sizing Manual — This 24-pp book presents a tested method for sizing control valves, the tools for which are company's size-ographs and Cv ratings. The size-ographs — for determining what valve must do — give flow equations for gas, steam and liquid services. The Cv ratings — for determining what valve will do — symbolize flow coefficients and serve as a yardstick for performance of diaphragm control valves, regulators, drainers and lever valves. Book also provides conversion equations, pressure-temperature ratings, other engineering data. Available to qualified power engineers, please state your job title. Black, Sivalls & Bryson, Inc.

UNIT HEATERS

131 Heater Selection Data — Catalog 155, 32 pp, presents unit heaters for steam and hot water in vertical and horizontal delivery and power-throw types. Cover design features and provides performance and capacity data. Also provides information on unit heater selection, sound ratings, locating unit heaters, motor wiring and control. Piping and installation, suggestions are included. Modine Mfg. Co.

132 Improved Unit Heaters — Bulletin 1301-A, 12 pp, describes propeller fan unit heaters for steam and hot water applications. Contains photos, drawings and technical data on the construction, application and installation of the newly redesigned line of heaters. Also includes piping arrangements. C. A. Dunham Co.

VALVES, PIPING AND ACCESSORIES

133 Bronze Valves — Form 1001 gives data on 200-lb bronze globe and angle valves, horizontal and angle checks. Gives features, service recommendations and general dimensions, information on composition and metal discs. The Ohio Injector Co.

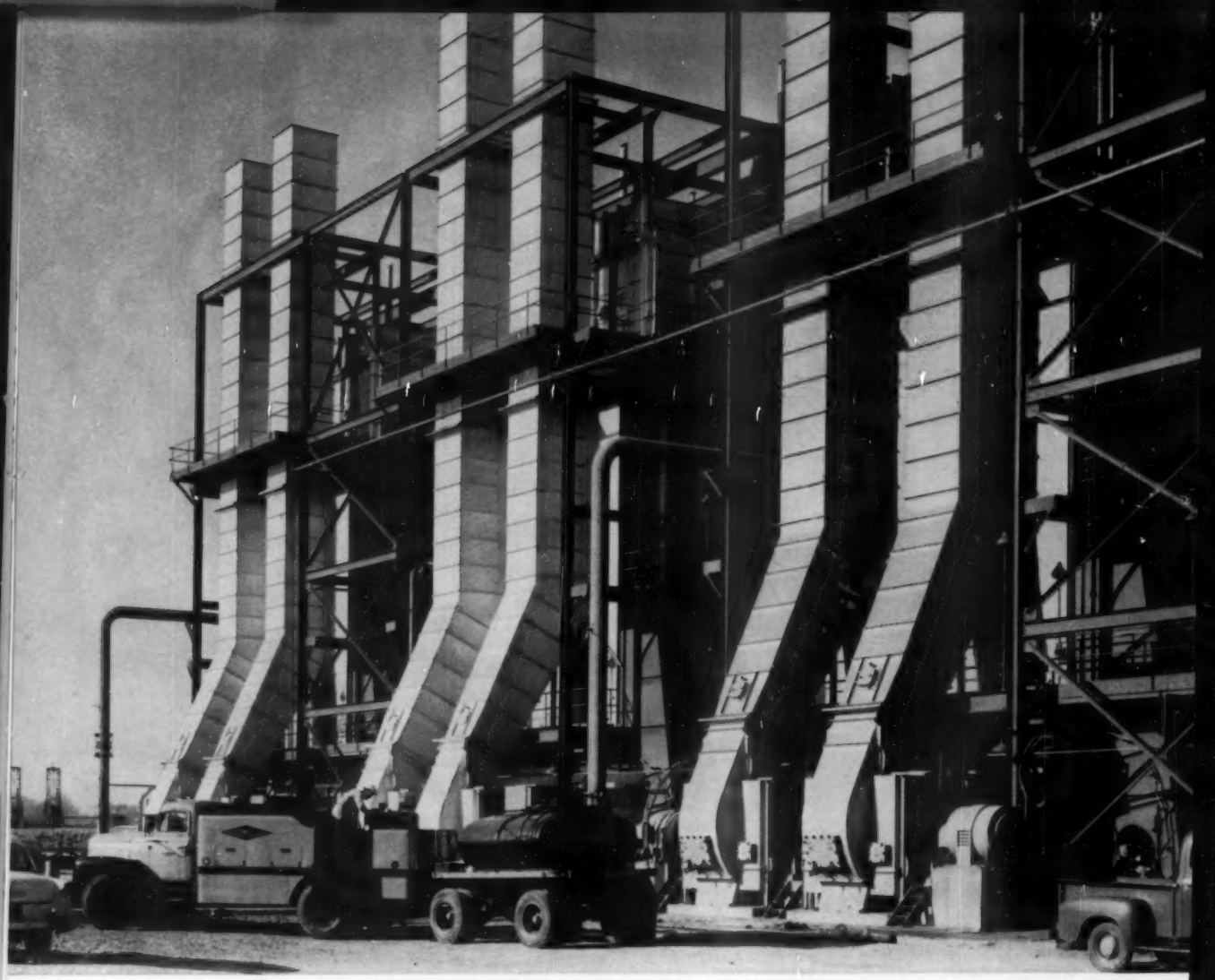
134 Valve Sealing Dramatized — "Super Seal Explains the 'Shear-Seal' Principle" is an 8-pp booklet utilizing the comic-strip sequence to demonstrate the sealing principle utilized in manufacturer's valves. In it, "Super Seal" (a clever beast) saws a manual valve in half, and explains how the internal parts function and how leakproof sealing is provided. Also provided in this informative booklet are some cut-out working models and a cross-section. Barksdale Valves.

135 Cartridge Air Valves — Bulletin V-150 describes company's line of cartridge air valves, featuring details on sizes, services, construction and parts. Diagrams of three basic types — solenoid operated, palm poppet operated, and lever poppet operated — are shown. Provides details on mounting brackets, overall sizes and specifications. Carter Controls, Inc.

136 Lubricated Plug Valves — Specifications, service recommendations and functions of this company's newly-designed lubricated plug valves in steel and semi-steel, are given in Form 1003. Text and illustrations show how this new design extends plug valve life. Wrenches, locking devices and lubrication accessories are also shown. The Ohio Injector Co.

137 Insulated Piping Systems — Prefabricated insulated piping units for underground or overhead systems are described and illustrated in this 24-pp booklet. Tells advantages of this insulated piping and gives specific application information on Uniline insulated units, insulated jacketed pipe units, prefabricated accessories, field connections. Shows features that make these units easier to install and pictures some applications. Specifications and trenching data are included, also conduit sizing chart. Booklet also describes cast iron insulated pipe units, and Utilidor conduits. Ric-wil, Inc.

138 Wrought Iron Pipe — Technical information required in specifying pipe and tubing is graphically presented in this 52-pp catalog. Tables list size and dimensional data of wrought iron pipe and tubular products. Data is also provided on wire and sheet metal gages, flow of water in gpm and conversion factors. Tables include size and dimensional data for various types of pipe, data on oil well tubing and casing, inserted joint casing and standard drive pipe, others. Supple-



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Regular program of DOWELL chemical cleaning for six boilers ended tube failures due to scale

The tubes of a 500,000 pph boiler in a chemical plant contained an extremely hard high-silicate scale up to 1/16-inch thick. Mechanical cleaning was unsatisfactory, because it required a long shutdown and still left hard scale in the tubes.

Dowell engineers formulated a special solvent and quickly removed the scale from the boiler. The operator now has all six of the 500,000 pph boilers on a regular schedule of Dowell chemical cleaning. Since the beginning of this program, the boilers have been cleaned several times and there have been no tube failures caused by scale deposits.

Chemical cleaning is designed to add years of life to your equipment by helping to protect it from over-heating, galvanic attack, and pitting-type corrosion. Downtime is held to a minimum, because solvents are introduced through regular connections . . . extensive dismantling and scaffolding are not needed.

Dowell Service brings you over a decade of experience in the chemical cleaning of many kinds of equipment, including more than 10,000 high- and low-pressure boilers. Contact the nearest Dowell office for more information. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. F-24.

chemical cleaning service for industry

DOWELL

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...THAT THE MATERIAL IS RIGHT—all W-S steel couplings and reducers are in accordance with ASTM Specification A-105—Grade 2.

...THAT THE MACHINING IS RIGHT—threads or sockets are accurately machined—perfectly aligned.

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Watson-Stillman Couplings and Reducers in your piping system mean true economy. They give you long, trouble-free service, insure strong, leakproof joints and readily withstand the effects of shock and vibration.

Strengthen your piping system with these Watson-Stillman fittings. Screw-End Type available in 3,000 and 6,000 lb. class, sizes ¼" to 6". Socket-Welding Fittings for schedule 40, 80, 160 and Double-Extra Heavy pipe in sizes ⅛" to 6".

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mentary tables give information on wrought iron physical characteristics and special properties, specifications of technical societies. A. M. Byers Co.

139 Rigid Plastic Fabrications — Eight-pp Bulletin 9–2 describes company's line of rigid plastic fabrications and pipe. Outlines use of Type I polyvinyl chloride in the fabrication of exhaust systems, and process equipment. Resistance characteristics and physical properties of the plastic are provided. Also included is a section on plastic pipe and fittings. Descriptions and tables on chemical and physical properties of Type I and II polyvinyl chloride and styrene copolymer rubber resin blend rigid plastic pipe are given. The Atlas Mineral Products Co.

140 Blinds, Spacers and Figure 8's — Sixteen-pp Section I catalog illustrates and describes company's line of pipe line blinds, spacer rings and figure 8's. Various types of blinds for ring type flanges are treated. All pipe sizes from 1 to 24 in. are tabulated in pressure ratings of 150, 300, 400 and 600 psig. Company announces that this handbook, devoted primarily to raised face items, is the first section of a proposed catalog on all types of ring type joint blinds, spacers and figure 8's. Engineering Corp. of America.

141 Line Blinds — Twelve-pp Bulletin MB-1–2M on company's Micro-Blanks is announced as the first standard bulletin on equipment known as line blinds, figure 8 blinds, spectacle blinds or blanking discs. Compiled for simplified ordering, bulletin covers Micro-Blanks designed in accordance with API-ASME Code formula for the pressure recommended for the flange it will fit. M. N. Aitken Co.

HOSE

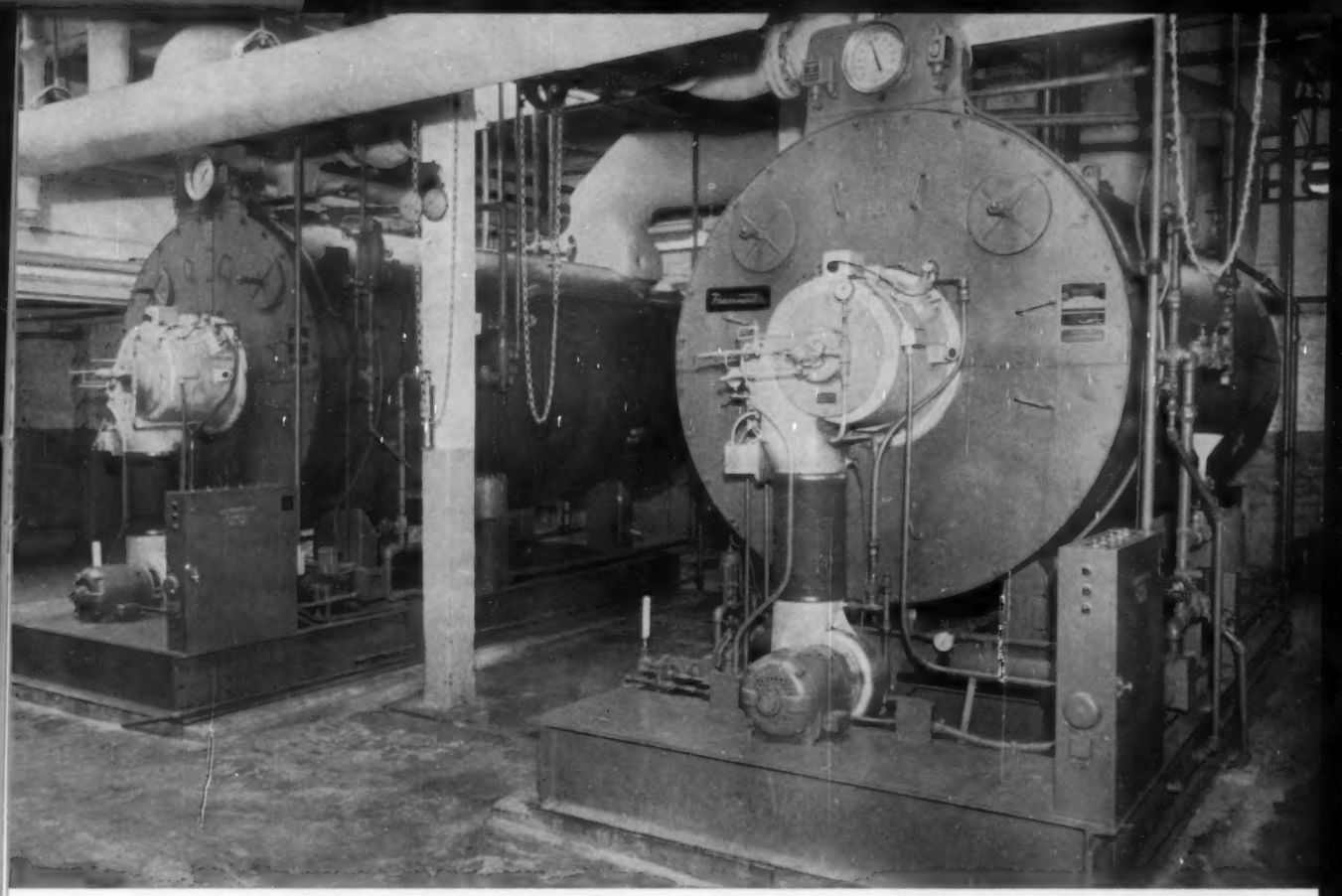
142 Flexible Metal Hose — Twelve-pp Catalog 147 covers this company's Rex-Weld corrugated metal hose, Rex-Tube convoluted hose, Rex-Flex stainless steel flexible metal hose, and special purposes assemblies. Complete coupling data is also provided. Specifications, sizes, suggestions for use are given and typical applications pictured. Flexonics Corp.

143 Industrial Hose — These four industrial hose catalogs covering welding, steam, air and petroleum hose are designed to aid in the selection of hose best suited for the particular application. Catalogs list recommended uses, construction, and specifications as to size, weight, and recommended working pressures. Cut away illustrations show construction of each type. Boston Woven Hose & Rubber Co.

TURBINES

144 Hydraulic Turbines — Bulletin 1001, 22-pp, illustrates company's hydraulic turbine research facilities and describes types of hydraulic turbines and associated equipment built for various hydroelectric projects. Also contains approximate equations for use as a guide in preliminary selection of turbine speeds and sizes for application to given conditions of head and horsepower, or turbine discharge. Baldwin-Lima-Hamilton Corp.

145 Single-Stage Steam Turbines — Bulletin 1954-C, 8-pp, describes single-stage steam turbines with steel casing construction. A cutaway view of a typical unit shows standard features. Information on the availability of various frames for



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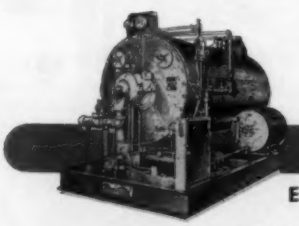
These two 200 HP *Powermaster* Packaged Automatic Boilers are saving 50% of steam costs annually for a large manufacturer of clothing. In addition, they are providing hotter, drier steam for processing and comfort heating.

Completely factory assembled and fire-tested *Powermasters* have gained world-wide acceptance as dependable producers of low-cost steam or hot water. And now, you can put a *Powermaster* in your plant or building on the Pay-As-You-SAVE Purchase Plan, that helps you pay for your new boiler out of its own savings.

Write for Bulletin 1220, or ask our representative to explain why it pays to modernize with *Powermaster*.



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single-stage applications, details on variable speed governors are included. Photos and descriptions of special features, along with a longitudinal diagram, present a picture of the machine's operation. A chart lists dimensions. Worthington Corp.

146 Pump-Turbines — Bulletin 02R8245 on pump-turbines contains a description of generator-motor units for reversible pump-turbines. Tells how pump-turbines are proving an economical way to smooth load curves by providing both off-peak and peak-load power. Explains how the electrical half of a reversible pump-storage unit differs from a normal hydro-generator. Allis-Chalmers Mfg. Co.

WATER TREATING

147 For Water Wells — An acidizing service for water wells, designed to increase water yield by enlarging formation channels and by removing scale deposits from pumps and screens is described in this folder. Lists advantages of this service, and cites some case histories. Dowell Inc.

148 Waste Treatment — A concise discussion of the basic types of equipment available for industrial and municipal waste treatment is included along with photos of typical installations in Bulletin WC-117. Advantages of treatment are told. Graver Water Conditioning Co.

COOLING

149 Air-Conditioning Cooling Tower — Bulletin WT & CT 583, 16-pp, on cooling towers used with air compressors, presents operating characteristics, specifications, selection, and installation of 20 standard commercial cooling towers, from 5 through 60-ton capacities. Several pages are devoted to tables, drawings and graphs. Bulletin contains a comprehensive table of cooling tower nominal ratings for both 78 and 75-deg wet bulb temperatures, outlet water temperature plotted against wet bulb temperature, tower capacity plotted against wet bulb temperature, layouts for year-round operation and inside use. Halstead & Mitchell.

150 On Cooling Tower Wood — The protection of cooling tower wood is the subject of Technical Paper 130. Explains how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi. W. H. & L. D. Betz.

151 Cooling with Air — Solo-aire units, for services directly using ambient air for cooling, and Combin-aire "packaged" integrated systems, which utilize a combination of maximum air and minimum water, are described in this 20-pp booklet. Covers application of these units alone and in combination, pictures some installations and cites case histories. Also describes the Auto-variable fan (for Solo-aire units) which provides automatic control of outlet temperature of cooled fluid. Booklet includes information on prime movers, speed changers and fan mountings available. Hudson Engineering Corp.

SAFETY

152 Industrial Safety Equipment — Designed as a safety manual, 65-pp Catalog 54 is divided into sections on eye protection, head protection, respiratory protection, and welding. Illustrations, de-

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Maxisafe DURAGAUGES

Turn the knob on the back of the *Maxisafe* and the plate comes off, fully exposing the entire mechanism for fast and easy inspection, recalibration or adjustment. This time and money-saving feature is highly favored wherever Ashcroft *Maxisafe* Duragauges are in service.

This Duragauge was named *Maxisafe* because it has an integrally-cast wall to separate the dial from the movement and Bourdon Tube assembly — a solid wall of safety that protects the viewer if the tube ever ruptures. Covering the back of the case is a double spring mounted safety release plate — a Teflon-coated plate tightly fitted on a rubber gasket and held in place by a knurled knob. Less than 0.5 psi pressure created by a ruptured tube forces this cover open — vents the discharge safely to the rear.

The Maxisafe is available in 4½", 6" and 8½" dial sizes. You can have a choice of standard Ashcroft Duragauge pressure ranges, case designs (except Types 1179 and 1279), and mountings. Get the utmost in sustained accuracy, durability, protection and convenient servicing. Specify Ashcroft *Maxisafe* Duragauges.

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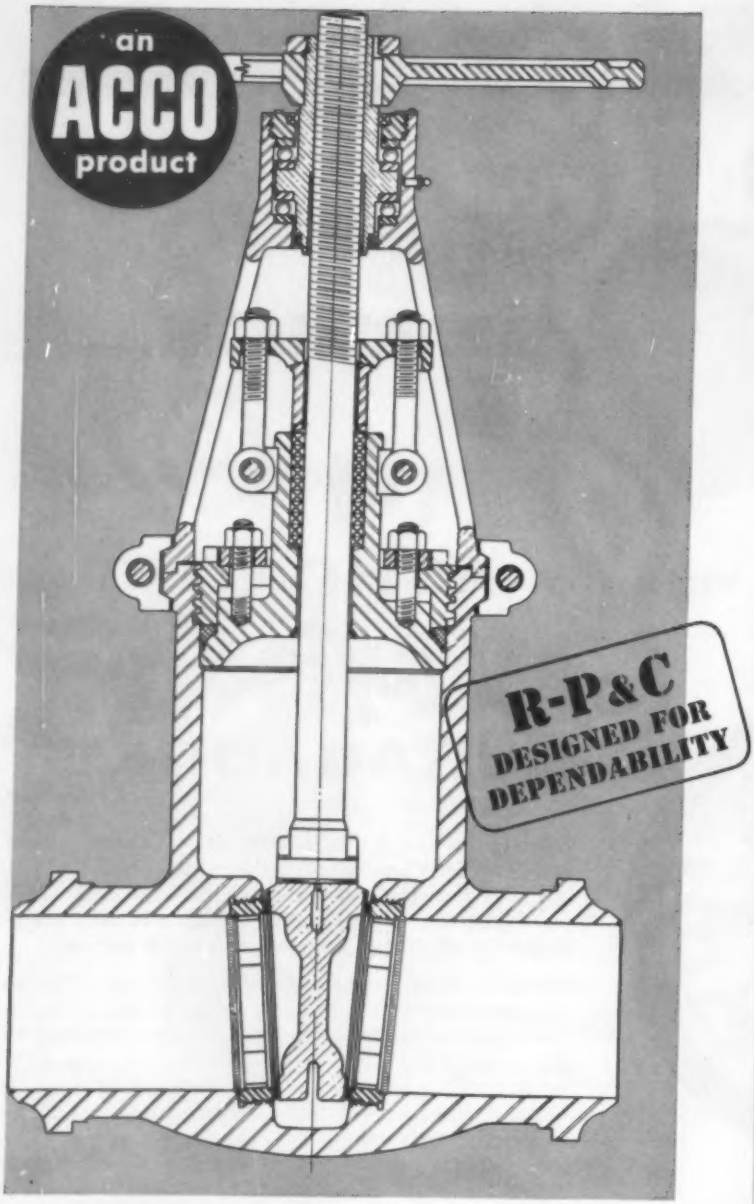

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For more data circle 525 on Post Card

scriptions, and ordering information are correlated. Discusses lens materials, frame dimensions and accessories, and offers information on different types of safety spectacles. Common dust, mist, fume, gas and vapor hazards are listed and proper respirator for each is shown. Willson Products, Inc.

153 Safety Signs — Illustrated in full color, 16-pp Bulletin 145-C presents basic purpose and specific purpose accident prevention signs for use individually or in combination. They include danger signs, caution signs, directional purpose signs, informational signs, safety instruction signs, fire signs and special signs. Stresses easy application of these self-sticking signs at point of hazard. Gives data on sizes and includes samples. W. H. Brady Co.

OTHER EQUIPMENT

154 Self-Contained Boilers — Bulletin AD-144 reviews company's new CB boilers. Illustrations include installations, demonstrations. Engineering articles are featured covering such subjects as low noise level. Cleaver-Brooks Co.

155 Aftercoolers, Separators — Bulletin 711, 12 pp, describes cyclone separators and pipe line aftercoolers for compressed air systems. Prepared to aid power engineers in taking a realistic cost accounting of their compressed air systems, it offers suggestions as to the scope of such an accounting, and a check list for analyzing the efficiency of the job being done by aftercoolers now in use. Also provides a chart covering moisture content of air under pressure at various system temperatures. R. P. Adams Co., Inc.

Postage-free cards for ordering catalogs are on pages 117-118. You may also use the cards to ask for further information on the advertised products.

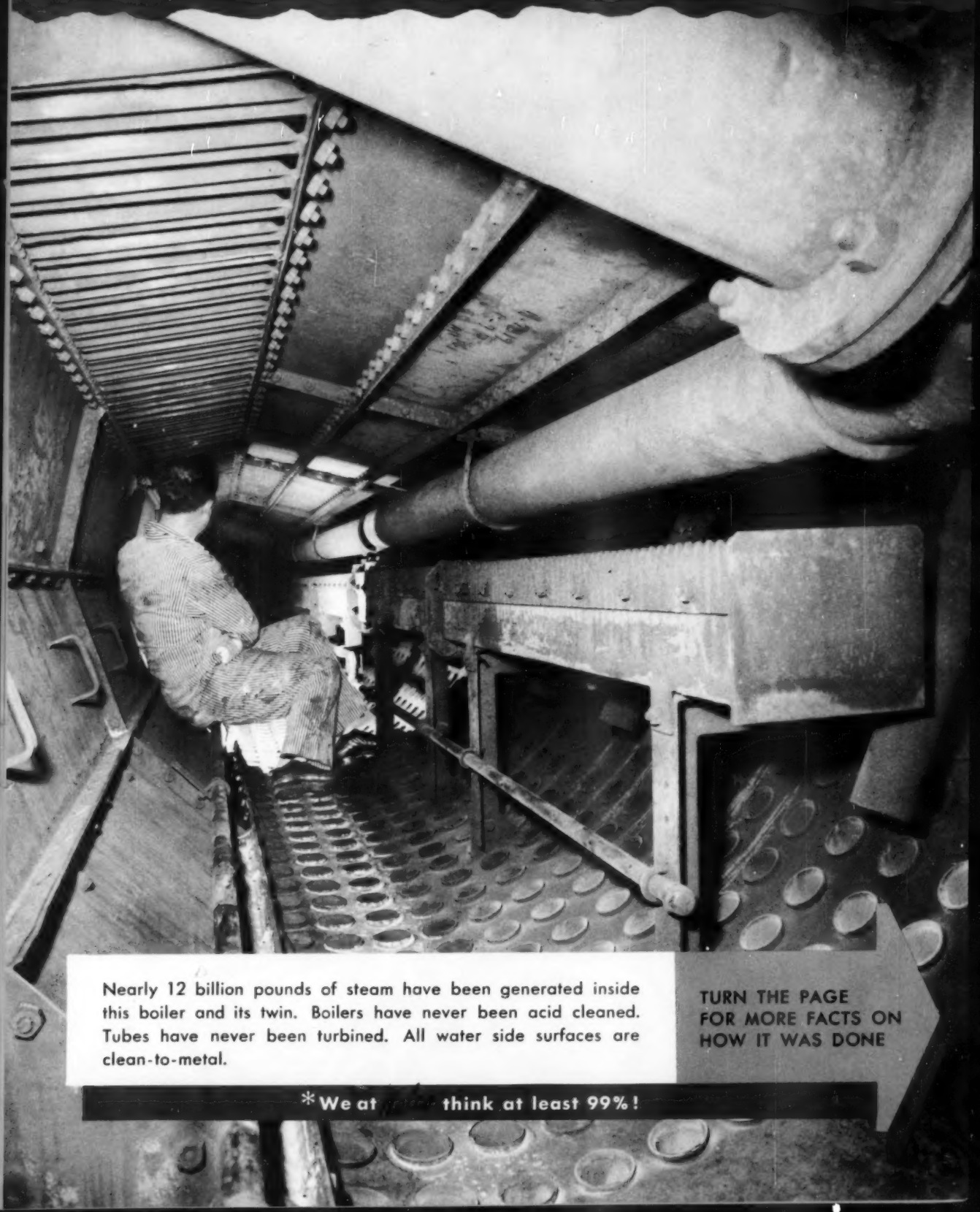
156 A Philadelphia Story — Geographic Study GS-10, an 8-pp booklet, covers the use of electronic air cleaning equipment in Philadelphia. Discusses advantages provided by such equipment in diversified applications in some of the city's prominent office buildings, Convention Hall, department store, industrial plants and others. Trion, Inc.

157 Packings, Gasket Cutters — This 48-pp catalog features a line of rod and sheet packings, gasket cutters, and accessory items to meet various industrial requirements. In addition to general service packings, there are braided, semimetallic, and high-pressure packings. Each style is described as to construction, applications, and forms, and numerous photos are included. A general recommendation chart, and an outline of the forms of packing available are given, along with general engineering data. The Allpax Co., Inc.

158 Lubrication Wall Chart — This handy wall chart contains lubrication recommendations for many industrial needs. Covers such applications as hydraulic systems, spindles, air compressors, reduction gears, electric motors, others. E. F. Houghton & Co.

more Bulletins on page 126

Proof of PERFECT* Water Treatment PERFORMANCE



Nearly 12 billion pounds of steam have been generated inside this boiler and its twin. Boilers have never been acid cleaned. Tubes have never been turbined. All water side surfaces are clean-to-metal.

TURN THE PAGE FOR MORE FACTS ON HOW IT WAS DONE

*We at [redacted] think at least 99%!

PERFECT WATER TREATMENT PERFORMANCE (CONTINUED)

BOILER OPERATING DATA

● Two new boilers were put on line in a Southwestern municipal utility plant at the same time late in 1949. Rated capacity of each unit is 250,000 pounds of steam per hour at 950 p.s.i. Normal operating rates range from 150,000 to 175,000 pounds of steam per hour per unit.

The Nalco System of water treatment has been used continuously in these boilers. Raw water softening is by Nalcite* Ion Exchange Resins, and other Nalco products are used for after-treatment, internal treatment, and condensate return line protection. Results have been perfect. Boilers have never been turbined or acid cleaned, and are opened only for annual internal inspection.

Registered Trademark

CLEAN . . . FOR TOP HEAT TRANSFER EFFICIENCY
What appear to be chalk marks in this unretouched photo are scrape marks which indicate only the usual powdery film left on the metal when the boiler is drained.

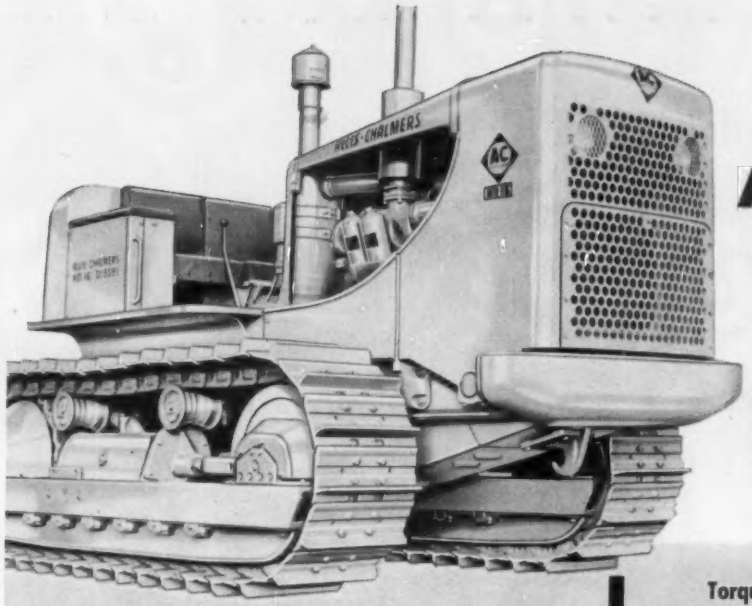
AND THE MUD DRUM IS SPOTLESS, TOO!
Another unretouched photo inside the mud drum of one of the boilers shows the like-new condition after years of service. No deposits or corrosion of any kind have been found in tubes or drums.

Nalco ON THE JOB

● Results like these are encountered every day in plants when the complete Nalco System of water treatment is on the job. The Nalco System is adaptable to old and new plants of any capacity, temperature, or pressure. Whether you operate a public utility or a space heating boiler, you will find your Nalco Representative of real assistance in the solution of your water treatment problems. Call him today, or write for full information.

NATIONAL ALUMINATE CORPORATION
6216 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science



Allis-Chalmers presents the NEW HD-16

Your choice of two outstanding drives

	Torque Converter Drive	Standard Transmission Drive
Horsepower	150 net engine hp	131 belt hp
Weight	31,600 lb	31,500 lb
Drawbar pull	up to 60,000 lb	up to 35,945 lb

Maximum drawbar pull limited, under normal tractive conditions, to 90 percent of total weight of tractor and mounted equipment

New Standards of Performance *for a wide range of heavy-duty work*

Set your sights on an HD-16! This big new tractor not only brings you *more* power for bigger jobs . . . it makes more effective use of horsepower, with a brand new Allis-Chalmers diesel engine and your choice of two new drives — the job-proved torque converter or the easy-shift standard transmission. Either way, the HD-16 brings you a new high in tractor-operator efficiency . . . a new high in work done under even the toughest conditions.

New Standards of Dependability *under all conditions*

The HD-16 follows the Allis-Chalmers *advanced basic design*, with such important features as its all-steel, Box-A main frame and one-piece steering clutch and final drive case . . . straddle-mounted final-drive gears with tapered roller bearings . . . unit construction . . . simplified lubrication and service designed with *better* maintenance in mind. What's more, it is newly engineered throughout to provide big safety factors in all components . . . plus outstanding new features like the new Allis-Chalmers heavy-duty diesel engine, new "wrap-around" radiator guard, husky new transmissions, new true-dimension track, and many others.

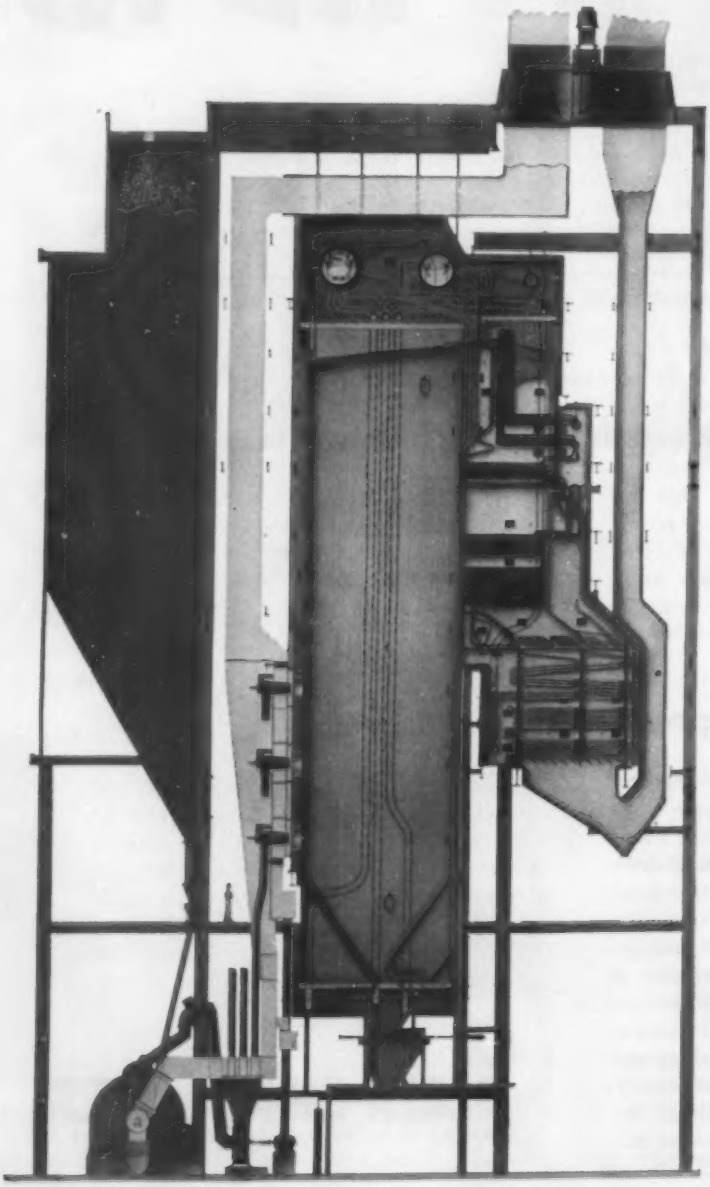
All in all, the new Allis-Chalmers HD-16 brings you an outstanding combination of performance and long life with both mounted and drawn equipment . . . a higher rate of production, more working time, more work done, LOWERED JOB COSTS. You OWE it to yourself to get all the facts now from your nearby Allis-Chalmers dealer.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

For more data circle 527 on Post Card

Now "on the line"— another

"FIRST" and "LARGEST"



World's first dual-circulation REHEAT unit and New York City's largest steam generator —designed and built by Foster Wheeler— serves new 180,000-kw generator at East River Station

Cross section of Foster Wheeler Dual Circulation Reheat Unit for the East River Station of the Consolidated Edison Company of New York, Inc.

To keep *ahead* of rapid load growth in the world's largest city, Consolidated Edison Company of New York has constantly anticipated the electric and steam needs of its customers.

Latest step in a long-range expansion program is the completion of Unit 7 at the East River Station. This new 180,000-kw generator is served by a Foster Wheeler 1,450,000 lb/hr dual-circulation reheat steam generator operating at 1850 psig, 1000 F/1000F and arranged for pulverized coal firing. It is the first combination unit of this type ever built and the largest steam generator in New York City.

Through the application of the Foster Wheeler dual-circulation principle it is expected that steam of extremely high purity will be produced, particularly with respect to vaporized silica. The radiant superheater, in combination with a convection superheater, enables full primary steam temperature to be attained at from 35% to 100% of rated load. The reheater, located in the low-temperature zone after the convection superheater, provides protection against all variables in operation. This combined dual-circulation reheat unit is conservatively rated, with low heat-absorption rates per unit area and low furnace exit gas temperatures. FW turbulent burners and FW ball mills further contribute to high fuel economy per pound of steam generated.

For further details on Foster Wheeler dual-circulation steam generators, send for your copy of Bulletin B-50-11.

FOSTER WHEELER

Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

For more data circle 528 on Post Card

CONSTRUCTION NEWS

Glendale, Ariz. — Salt River Power District, Glendale, will have plans prepared soon for new steam-electric generating plant on local site on 75th Ave., recently acquired. Station will be equipped for an initial capacity of 100,000-kw. Proposed to begin work on foundations early in fall, with plant to be completed in spring of 1957. A bond issue of $11,000,000 has been authorized for project, including transmission lines, power substations and other operating facilities.

Maricopa, Ariz. — Electrical District No. 3, Pinal County, Maricopa, has been authorized to issue bonds for $6,740,000 for new steam-electric generating plant on local site, recently noted in these columns, and will have plans prepared at once. A tract of land is being acquired. Plant will have an initial rating of 30,000-kw., and is estimated to cost $4,800,000, with remainder of fund noted to be used for installation of transmission lines in different parts of county, power substations and other operating facilities. Fell & Wheeler, 6339 East Tecumseh St., Tulsa, Okla., are consulting engineers.

Los Angeles, Calif. — Dept. of Water & Power, 311 South Spring St., has work in progress on new Scattergood steam-electric generating plant on boundary of Los Angeles-El Segundo, near International Airport, previously referred to in these columns. Awards are being made for primary equipment, including two 156,000-kw. turbine generator units and high pressure boilers. Initial unit is scheduled to be ready for service in January 1957, and second unit in January 1959. Entire project is estimated to cost about $50,000,000.

Los Angeles, Calif. — Southern California Edison Co., 601 West Fifth St., has disposed of a bond issue totaling about $40,000,000, proceeds to be used in part in connection with 1955 expansion and improvement program, including increased generating facilities at hydroelectric and steam generating plants, transmission lines, power substations, other facilities.

St. Petersburg, Fla. — Florida Power Corp. has arranged a construction budget to cost about $29,000,000 in 1955, including increased generating capacity, extensions in transmission lines, power substations and other operating facilities.

Atlanta, Ga. — Georgia Power Co., Electric and Gas Bldg., has authorized a construction budget of about $33,400,000 for 1955, including expansion and improvements in generating stations, transmission lines, power substations, other operating facilities.

New Albany, Ind. — Public Service Co. of Indiana, Inc., Indianapolis, Ind., plans new steam-electric generating plant on Ohio River, near New Albany, to be equipped for a rated output of 300,000-kw., divided into two 150,000-kw. turbine generator units, with high pressure boilers and accessory equipment. Project will represent a reported investment of about $45,000,000.

Sioux City, Iowa — Iowa Public Service Co., 515 Fifth St., has arranged financing through the sale of a block of common stock, to total about $4,300,000, majority of proceeds to be used for 1955 expansion and improvement program, including generating facilities, power substations, transmission lines, etc.

Henderson, Ky. — Municipal Light Department has approved plans and will proceed with work at once on new addition to municipal steam-electric power plant. Work will include installation of new 12,650-kw. generator unit, high pressure boiler and auxiliary equipment. As recently noted in these columns, a bond issue of $3,000,000 has been authorized for project. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

Lexington, Ky. — Kentucky Utilities Co., 159 West Main St., has disposed of a bond issue of $5,000,000, proceeds to be used in connection with 1955 construction budget, including increased power facilities, transmission lines, power substations and other work.

Augusta, Me. — Central Maine Power Co., 9 Green St., has arranged for bond issue to total about $12,000,000, a considerable portion of proceeds to be used in connection with 1955 expansion and improvement program, including generating stations, transmission lines, power substations and other operating facilities.

Detroit, Mich. — Chrysler Corp., 341 Massachusetts Ave., automobiles, has completed plans for expansion in power plant at automobile body works on East Jefferson Ave., recently referred to in these columns, and will proceed with program at once. This is part of a general expansion project at plant for increased production, representing a reported cost of $20,000,000. Albert Kahn Associated Architects & Engineers, New Center Bldg., Detroit, is architect and engineer. It is understood that construction work will be carried out by J. A. Utley Co., 723 East 10-Mile Rd., Ferndale, Mich.

Asbury Park, N. J. — Jersey Central Light & Power Co., 501 Grand Ave., has arranged for bond issue of $20,000,000, proceeds to be used in connection with 1955 construction program, including extensions in generating facilities, transmission lines, power substations and other work.

Hobbs, N. M. — Southwestern Public Service Co., Amarillo, Tex., has plans under way for new electric generating plant at Hobbs, where site has been selected. Installation will include two or more 26,000-hp. generating units and auxiliary equipment. Proposed to begin work in fall. Project reported to cost about $8,000,000, with transmission lines, power substations and other facilities.

Astoria, L. I., N. Y. — Consolidated Edison Co., 4 Irving Pl., New York, has authorized expansion in steam-electric power plant at Astoria, with installation of a new 300,000-kw. turbine generator unit, high pressure boilers and auxiliary equipment. Proposed to begin work in near future, with completion scheduled early in 1958. Entire project reported to cost over $50,000,000, including extensions in transmission lines, power substations and other operating facilities.

Mineola, L. I., N. Y. — Long Island Lighting Co., Mineola, has arranged financing in amount of $35,000,000, fund to be used for expansion and improvements in generating facilities, transmission lines, power substations and other work. As recently noted in these columns, company will expend about $60,000,000 in 1955 for construction and improvements.

Willard, N. Y. — State Department of Mental Hygiene, Albany, N. Y., has plans under way for new power plant at State Hospital at Willard, estimated to cost close to $3,000,000, with equipment. Program will be carried out by Department of Public Works, State Office Bldg., Albany.

Draper, N. C. — Duke Power Co., 422 South Church St., Charlotte, N. C., is carrying out an expansion program in local Dan River steam-electric generating plant, to include installation of new 150,000-kw. turbine generator unit and auxiliary equipment. Project is reported to cost about $16,000,000 and represents part of 1955 expansion and improvement program of company.

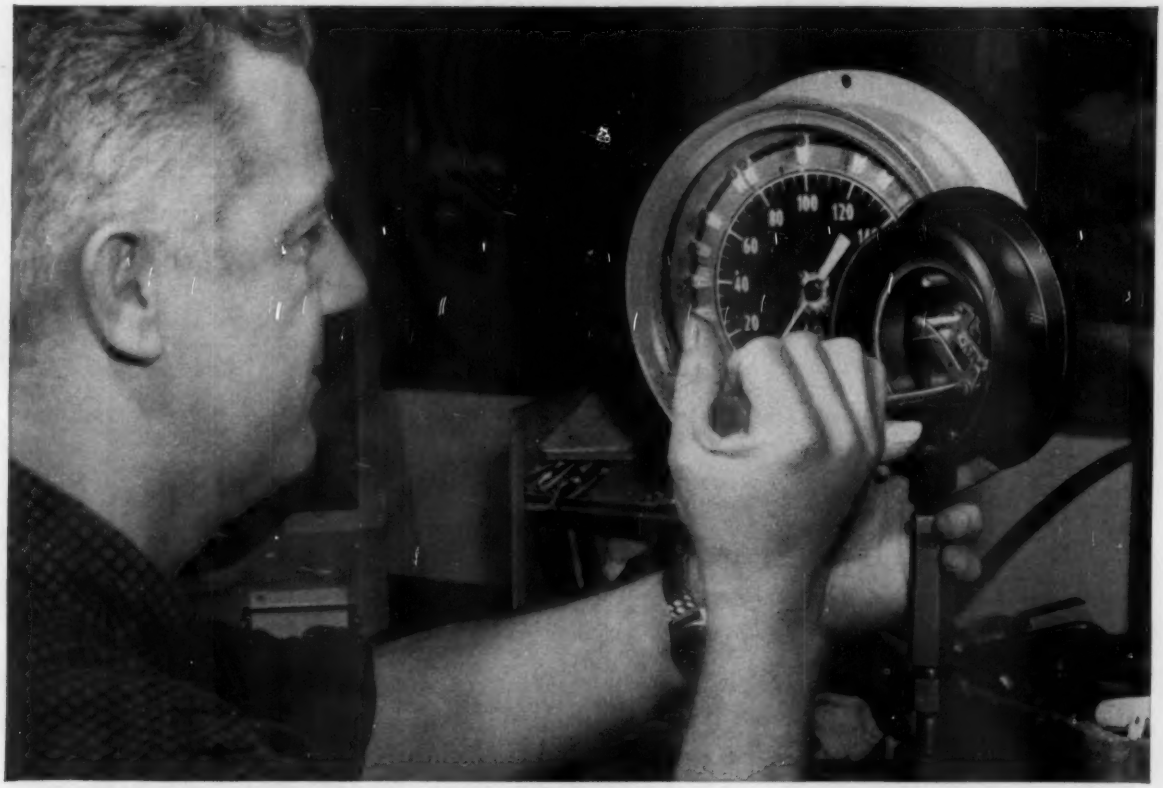
Akron, Ohio — Ohio Edison Co., Akron, has arranged for a bond issue of $30,000,000, proceeds to be used in connection with 1955 expansion and development program, estimated to cost close to $50,000,000, including increased generating facilities, power substations, transmission and distributing lines, and other work.

Canton, Ohio — Ohio Power Co., 301 Cleveland Ave., S.W., has authorized a construction budget of close to $40,000,000 for expansion and improvements in 1955, including generating facilities, transmission lines, power substations and other work.

Coshocton, Ohio — Columbus & Southern Ohio Electric Co., 215 North Front St., has authorized plans for new steam-electric generating station, near Coshocton. It will be equipped for an initial capacity of 125,000-kw. Coal will be used as fuel. Cost reported about $34,000,000. Proposed to begin work next fall and to have plant ready for service late in 1957.

Reading, Ohio — Municipal Electric Light & Water Department has authorized plans for new municipal power plant, to supplement present station. Cost reported close to $1,300,000, with generator unit, high pressure boiler and auxiliary equipment. Willard Pistler, 4 West Seventh St., Cincinnati, Ohio, is consulting engineer.

Yorktown, Va. — Virginia Electric & Power Co., Richmond, Va., has authorized plans for a new steam-electric generating station on York River, near Yorktown. Installation will include two turbine generator units, size and details now being determined, with high pressure boilers, designed to use coke and by-product gas as fuel. New station will be located near oil refinery of American Oil Co., now in course of construction, and will furnish service for that plant, as well as for company utility system. Fuel supply will be secured from oil refinery. Entire project is reported to cost about $20,000,000.



Accurate gauge — accurate setting. Worker calibrates a pressure gauge equipped with a "K" Monel Bourdon tube at the Manning, Maxwell and Moore plant in Stratford, Conn. The company was the first to use long-lasting, corrosion-resisting "K" Monel for Bourdon tubes in a pressure range of 15 psi to 100,000 psi.

For high-pressure, high-temperature service

Gauges with "K" Monel Bourdon tubing ideally suited to meet today's needs

Can your gauges stand up to higher operating pressures, higher temperatures, and corrosion?

Ashcroft gauges made with Bourdon tubing of "K"® Monel can! Successfully used in a pressure range of 15 psi to 100,000 psi, they may be the answer to your problem.

Like all Inco Nickel Alloys, "K" Monel is strong . . . tough . . . corrosion-resisting. In addition, it has the low hysteresis and drift needed to assure gauge accuracy, and the good fatigue strength necessary for long-term service.

In short, "K" Monel helps bring to your gauging equipment hairline accuracy . . . trouble-free performance . . . and extended life. *Check for "K" Monel Bourdon tubing in the gauges you buy.*

And remember that "K" Monel — or one of the more than 50 other Inco Nickel Alloys — may provide the answer to some of your other equipment problems, too. Particularly if those problems involve high pressures, high temperatures, and corrosion. For any help you need in making a selection, don't hesitate to call upon Inco's Technical Service Section. They're always glad to work with power plant men on specific problems.

Meanwhile, Technical Bulletin T-9, containing valuable material on *Engineering Properties of "K" Monel*, may prove helpful. Write us for a copy.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

More POWER for you . . . with "K" MONEL INCO TRADE MARK **NICKEL ALLOYS**

For more data circle 529 on Post Card

EQUIPMENT NEWS

1—DIAPHRAGM VALVE is made of rigid Koroseal

This diaphragm valve is announced as the first ever made of rigid Koroseal. Of simple straightway design, the valve is suggested for handling slurries, fluids, gases and corrosive materials at temperatures to 150 F and pressures to 150 lb. According to the company, the valve works like a simple pinch clamp and is closed by pressing a flexible diaphragm against the raised bottom which is curved to fit the diaphragm. When fully closed, the diaphragm is seated under pressure providing a cushioned, leakproof seal. The absence of pockets, corners, grooves or sharp changes in direction of flow makes the valve self-cleaning, it is pointed out. The valve does not require packing because the diaphragm seals off the valve stem and working parts from the solutions. No fluid can get to the stem to corrode the metal working parts, says manufacturer, and this prevents contamination of the product in the piping system and keeps lubricants from getting back into the product. The valve is available in sizes from ¼ to 2 in. The B. F. Goodrich Co.

2—ANTI-RUST PAINT gives low cost protection

Announced for low cost protection of exterior metal work, CI-88 incorporates a bituminous base with a special paint vehicle to produce a heavily bodied coating which can be applied on outside metal after a minimum of surface preparation. It is suggested for use on gutters, downspouts, stacks, flashings, railings, machinery, metal window sash, utility poles, tanks, metal fence posts. The manufacturer states that CI-88 dries to a semi-gloss finish and that it is intended for use as a finish coating and not as a primer. One application is said to be sufficient for most surfaces. It can be applied by brush, spray or dip and is available in 5-gal pails, 55-gal drums and tank car lots. Chem Industrial Co.

3—PIPE WRAP TAPE is plastic, all-weather insulation

This all-weather, polyvinyl chloride pipe wrap tape is announced as featuring increased adhesion and conformability even at freezing temperatures. According to manufacturer, it can be applied in temperatures as low as 0 F. Besides its low-temperature flexibility, this tape is said to feature an improved adhesive that sticks better at all temperatures and incorporates a built-in corrosion inhibitor.

Two types are available — Scotchrap Pipe Insulation No. 50, 10 mils thick, for wrapping fittings and wherever maximum conformability is necessary, and No. 51, 20 mils thick, for straight-run wrapping. These tapes are expected to find use for wrapping above-ground and buried pipes in tank farms, chemical works, and wherever corrosion is a problem. Minnesota Mining and Mfg. Co.

Reader Service Cards on pages 117–118 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

4—TUBE CLEANER for air conditioning systems

The electrically driven AB Tube Cleaner is announced for air conditioning condenser tubes ⅝ to ¾ in. OD. It is designed for simplicity of operation in rapid removal of algae, slime and mud deposits, and its use is claimed to result in immediate reduction of condenser head pressure. Equipped with a carrying handle and built-in base, the cleaner is lightweight and portable. It is powered by a ¼-hp 3450-rpm motor, available in 110–220 v a-c, single phase. Several types and lengths of flexible shafts and metallic casings are available for various tube sizes. The assembly is readily attached to the motor by means of a grooved spline connection, it is pointed out. Thomas C. Wilson, Inc.

5—STEAM PACKING for 1500 lb working pressure

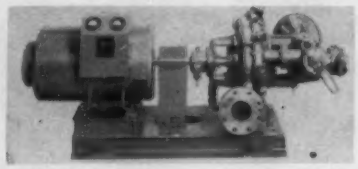
This steam valve-stem packing is designed for pressures up to 1500 lb and temperature of 1000 F. In it, long fiber asbestos yarn is combined with high tensile strength, fine filament monel insertion, and a high temperature lubricant that will not pit stainless steel stems is incorporated, manufacturer states. The packing is claimed to be successful in service under conditions on stationary and throttle valves. It will not boil out or shrink, it is noted, and it has good compressibility and recuperative powers. A. W. Chesterton Co.

6—UNIT HEATERS are gas-fired, horizontal discharge type

Included in this line of gas-fired utility heaters with horizontal discharge are two designs of unit heaters and a new duct type heater. Exterior casings have rounded contours and gray, baked enamel finish. The combustion chamber and heat exchanger are built of 16-gage aluminized steel, welded into a one-piece assembly. A built-in draft diverter is incorporated, it is pointed out, and four-bladed aluminum propeller type fans provide maximum air delivery at a low noise level. Automatic safety controls are provided. The heaters range in size from 50,000 to 230,000 Btu per hr input. L. J. Wing Mfg. Co.

7—TURBINE-GENERATORS are packaged power units

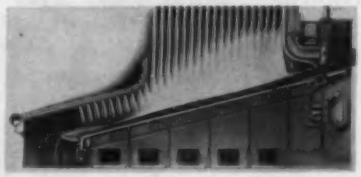
Type TFG Turbo-Generator Sets are packaged a-c single phase and 3-phase units designed for emergency lighting or where dependable lighting or power supply is required. They are compact ready-to-be-installed power units and require no switchboard. Ratings from



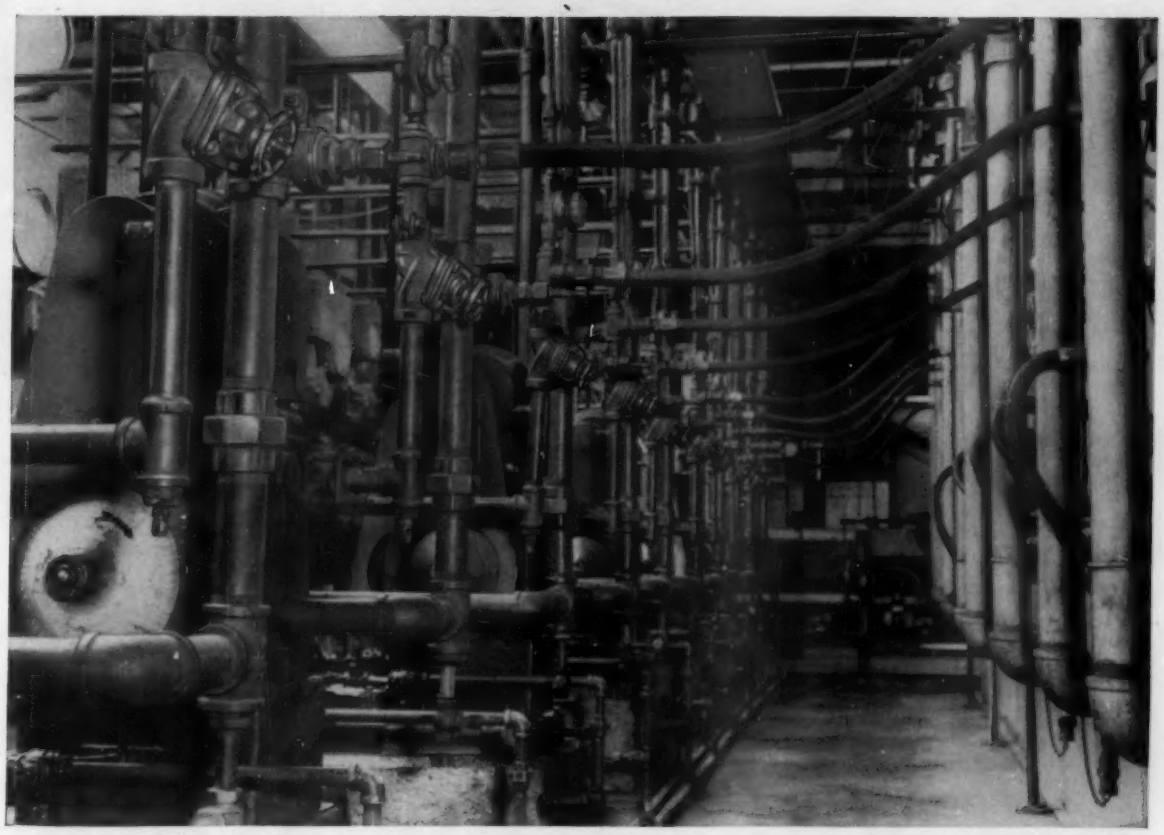
3.75 to 62.5 kva are available. Units consist of a type TF steam turbine with constant speed governor, excess speed safety trip, carbon ring glands, sentinel relief valve and steam strainer. Turbine is connected by a flexible coupling to packaged 1800 rpm generator with direct connected exciter and mounted control cabinet with voltmeter and ammeter. Unit is mounted on a welded structural steel base plate, with a sheet steel coupling guard. Bulletin 140-A gives more data. Coppus Engineering Corp.

8—WATER-COOLED STOKER handles economical coals

Vibra-Grate Stoker, with a vibrating block-covered water wall connected right into the boiler circulation, is said to burn most economical coals with top efficiency. The stoker is reported to bring



a combination of advantages, including freedom from smoke, even at low ratings, and ready adaptability for burning gas or oil in combination with coal, or singly. Fuel is moved by an intermittent vibrating motion imparted to the grate through a floating eccentric. This vibrating action levels and auto-compacts the fuel bed, says manufacturer; it leaves no holes or light or heavy spots and discharges ash simultaneously and automatically. The vibrating grate section forms bottom of coal hopper and



Holding high vacuum with low upkeep is routine for these CRANE VALVES

At the Crosley & Bendix Home Appliance Divs., Avco Mfg. Corp. refrigerator plant at Richmond, Ind., a line vacuum within a few microns of absolute is applied to a dehydration process. But holding this vacuum wasn't always a routine operation.

There was a time when frequent valve failures caused production losses and costly maintenance—stopped only when Crane Packless Diaphragm Valves were installed.

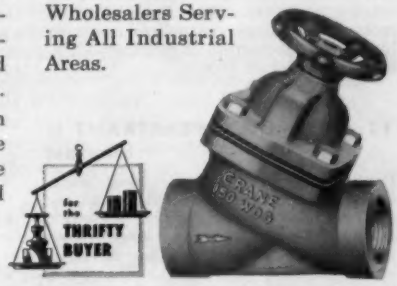
Of the valves formerly used, a multiple metal diaphragm type lasted about 3 months. Crowning of diaphragms caused restriction or closure and made the valves inoperable. Damaged diaphragms meant complete valve replacements.

In other valves, in-leakage at the diaphragm-to-stem connection made them unsatisfactory.

Now in service more than a year, none of the Crane Kel-F Diaphragm Valves has needed any maintenance. Crane simplified construction, giving a longer-life diaphragm... tighter bonnet seal and seating . . . and easier operation . . . is the reason.

The diaphragm in Crane design has longer life because it seals the bonnet only—is not subject to the cutting and crushing encountered when also used for seating. The separate, positive seating disc controls fluid even should diaphragm fail. Wide selection of body materials and trims. Ask your Crane Representative for Circular AD-1942.

Crane Co., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. Branches and Wholesalers Serving All Industrial Areas.



CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

For more data circle 530 on Post Card

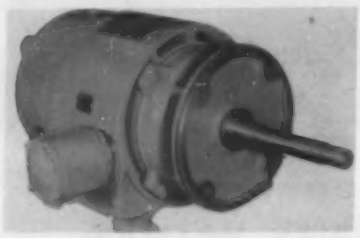
assures constant coal feed regardless of moisture content. The stoker is available in standard capacity ranges from 25,000 to 100,000 lb of steam per hr. American Engineering Co.

9—ELECTRICAL TAPE utilizes a silicone adhesive

Brand PD 300 Mylar Tape utilizes an inorganic silicone adhesive and is announced as having a dielectric strength of 9000 v. This pressure-sensitive tape has no corrosive effect on copper, says company, and its electrolytic corrosion factor is less than 1.0. In temperature performance tests it is reported to have bonded within a range of from — 80 to 300 F. Manufacturer says it offers excellent resistance to solvents, oil and water immersion, staining and abrasion — as well as to aging on the shelf. Mystik Adhesive Products.

10—PUMP MOTORS designed for hazardous or dusty areas

This line of totally-enclosed and explosion proof, close-coupled pump motors, available in 1½ to 25 hp ratings, is designed specifically for use with centrifugal pumps operating in dangerous, damp or dusty locations. Features include a

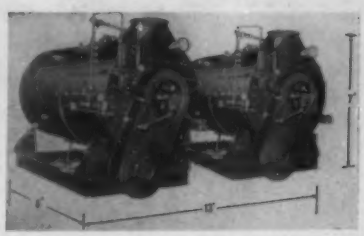


face type registered mounting bracket for accurate shaft alignment, simplified pump mounting, solid flange and brass slinger for complete liquid deflection.

According to manufacturer, these units are completely sealed for use in locations where destructive dusts, acid fumes, excessive moisture, or other harmful substances prevail. Larger ratings are double-enclosed and fan ventilated for rapid heat dissipation. Smaller ratings are self-cooled by radiation. The models are fitted with a specially sealed conduit box, elongated bearing sleeves, sparkproof aluminum fan and long bracket registers. They have asbestos-protected windings, normalized castings, Lubriflush lubrication of bearings. U. S. Electrical Motors Inc.

11—NON-OILY PENETRANT is odorless

Particularly suited to electrical work, Puritan Penetrant is described as the first non-oily penetrant for loosening corroded nuts or bolts and larger seized parts of appliances and other electrical or mechanical equipment. The penetrant is nonflammable and odorless, says company, and since it is fast acting and deeply penetrating, it does not spread over the work. The penetrant can be applied by pour spout or squirt gun. After several minutes, the work is tapped lightly. Parts can then be disassembled, using the proper tools. Olin Mathieson Chemical Corp.



12—TWIN-UNIT BOILERS can deliver 10,000 lb of steam

Utilizing only 104 sq ft of floor area and only 728 cu ft of plant space, this twin-unit package boiler installation is designed to deliver 10,000 lb of steam per hour — each unit delivering 5000 lb. The units — designated C-5000 — are each 8 ft long, 5 ft 1 in. wide and 7 ft high, and a 2 ft 10 in. aisle is left between them for servicing. Furnished with modulating equipment, one of these boilers can produce steam at one-third rated capacity, or 1300 lb of steam per hour. In this way, the twin-package can handle fluctuating loads from 1300 to 10,000 lb maximum with no lag in steam production throughout the cycling range. Operating pressures are available to 200 psi. Equipped with variable capacity burner nozzles, the units burn oil, gas, or a combination of the two. Cyclotherm Div., United States Radiator Corp.

13—JOINTED STEEL RULE also serves as a protractor

Highly practical in measuring both longitudinal and angular dimensions is this jointed stainless steel 2-ft rule. It has a scale of chords engraved on one side from 0 to 120 advancing by half degrees and is also provided with two center dots, one on each blade, by which, when using a pair of dividers, the rule can be set to any desired angle — or any angle can be determined. The rule has graduations reading in $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$ and $\frac{1}{64}$ in. The joint has a spring tension which supplies sufficient friction to hold the angle setting rigid for scribing and layout work. Economical in cost, this two-purpose rule sells for around $3.50. George Scherr Co., Inc.

14—LOW FRICTION TREATMENT for rubber parts

Gorlube is a low friction treatment for application to O-rings and other parts made of natural, synthetic and silicone rubbers. Extension of the life of parts where minimum wear is important is claimed. Depending on the function and the part, the Gorlube treatment is given either by impregnation or coating. Goshen Rubber Co. Inc.

15—REFRACTORY RAMMER designed to prevent recoil shock

The Model G-162D is light and easily handled, says manufacturer, and it delivers a controlled, powerful, recoilless stroke. In addition to increased efficiency, this recoilless feature means safer operation, it is pointed out; the elimination of severe vibration and kickback protects operator against discomfort and injury. This rammer has twin rubber grip handles, and the rear one can be rotated on its mounting for better positioning of the rammer and greater ease of control and operation. The front grip houses the trigger and is located under the center of balance for one-hand operation.

Made with a bronze lined alloy aluminum body and hard chrome piston, this rammer operates at usual shop air pressure. It is normally supplied with a 3-in. diam circular ramming head, but can be equipped with shafts of varying lengths and heads with larger or smaller diameters or irregular shapes. Vibron Div., Burgess-Sterbentz Corp.

16—EXHAUST SILENCERS reduce high-low frequency noises

The snubbing principle of this company's intake and exhaust silencers has now been adapted to a new line of acoustic discharge silencers. This new type is designed to eliminate high and low frequency noises caused from gas, steam and air operated equipment. Acoustic reactance chambers employing special sound absorbing material are used in the design. They are said to satisfy the needs in both critical and non-critical areas. Silencers mount on the exhaust of steam vents, gas turbines, hogging jets, evacuating ejectors and reduce the sharp, noise producing impulses of discharging gases to an even, constant flow. They come in standard 8 to 30 in. pipe sizes, and special sizes may be engineered. Burgess-Manning Co.

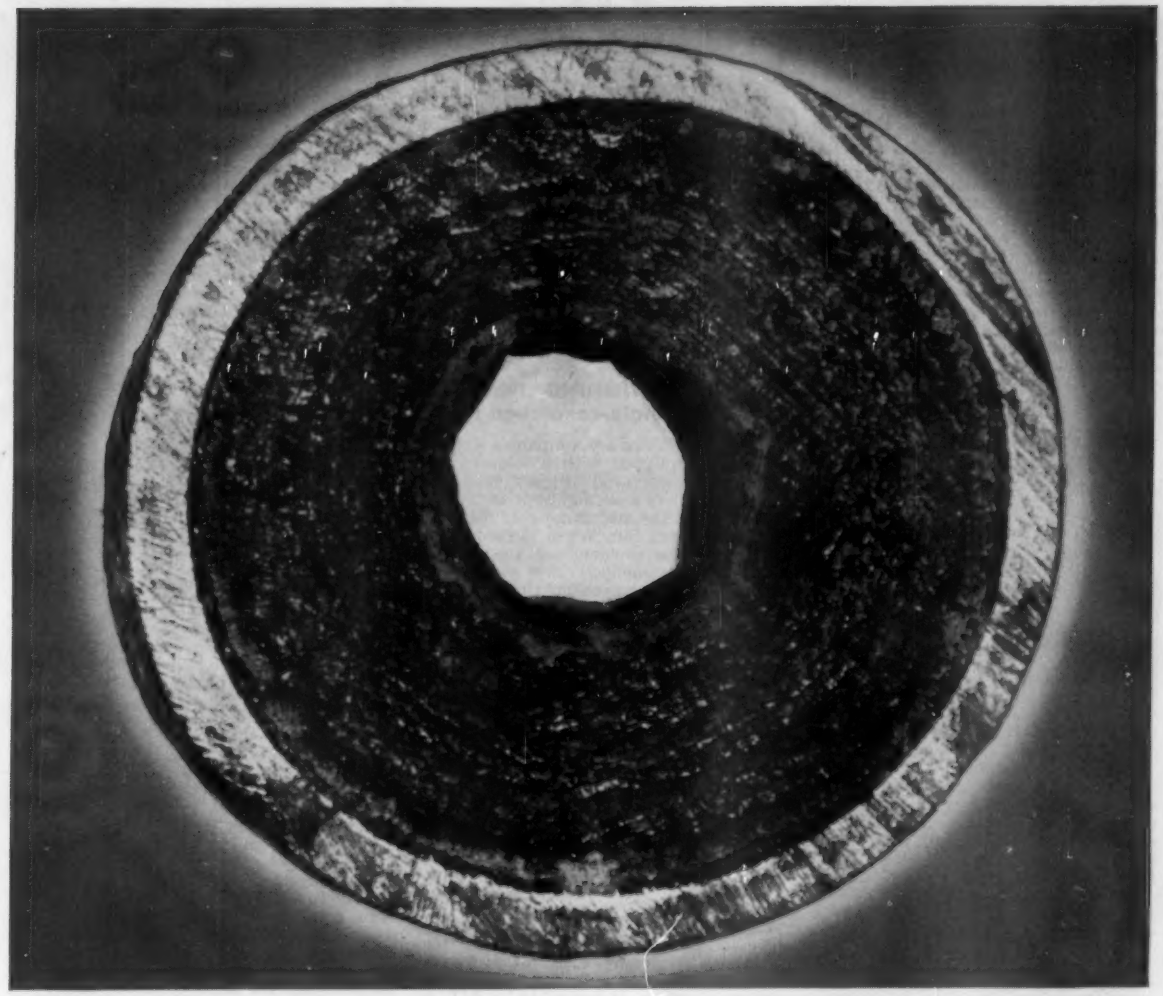
17—CONTROLLED VOLUME PUMP for the super pressures

Engineered for control of fluid flow at pressures from 7500 to 50,000 psi, this controlled volume pump is announced for high pressure synthesis, hydrostatic pressure testing and high pressure fluid

metering. According to manufacturer, this pump provides precise metering accuracy at higher capacities as well as higher pressures. Seven units cover the pressure range. Maximum capacity at 50,000 psi is 12.5 gph; at 7500 psi, 94 gph. Materials of construction below 25,000 psi are 300-series stainless steel with 400 series trim. Above 25,000 psi, materials are Ni-Cr-Mo steel with tungsten carbide trim. High volumetric efficiency is assured, says company, because complete scavenging of the liquid end displacement chamber is provided at all plunger length settings. Milton Roy Co.

18—BRAKE-MOTOR offers positive stopping action

This totally enclosed, fan-cooled, fractional horsepower brake-motor is designed for applications where positive



END OF THE LINE

SCALE—layer upon layer of it—has reduced the inside diameter of this pipe to practically nothing. It's a common occurrence in some power plants, and the results are costly. The line must be taken out of service. That means production loss and expensive maintenance or replacement.

Scale, sludge, carry-over, and return-line corrosion are but a few of the problems that must be overcome to assure efficiency in boiler plant operation. In Dearborn's complete line of water conditioning products, there is the correct treatment to eliminate every water trouble—the properly balanced treatment to reduce unnecessary maintenance, avoid shutdowns, and protect valuable equipment.

Since 1887, Dearborn products have provided trouble-free water to users of steam in all types of industry. That's why, today, power engineers in leading industrial plants throughout the nation look to Dearborn for consultation and assistance in solving their water treating problems.

Dearborn®

...a leader in water conditioning and corrosion control

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Dearborn Chemical Company, Dept. PG
Merchandise Mart Plaza, Chicago 54, Ill.
Please send me complete information on Dearborn Water Conditioning.

Name.....*Title*.....
Company.....
Address.....
City.....*Zone*....*State*.....

For more data circle 531 on Post Card

stopping or holding of loads in position is desired. The brake has been designed to fit company's small-size Form G motor, and together they make a compact, lightweight unit, company engineers say. Combined manual release and wear indicator is recessed in brake housing for quick, visual inspection. A large finger recess permits manual release even by a workman wearing gloves. According to company, the type of brake lining used makes adjustment virtually unnecessary for life of the brake on most applications. However, when required, adjustment can be made easily without special tools. The brake is spring-set and solenoid-released. In event of a power failure, it automatically sets, giving added protection. Brake-motors are available in ⅛, ⅙, ½, and ¾ hp ratings, 1725 rpm. General Electric Co.

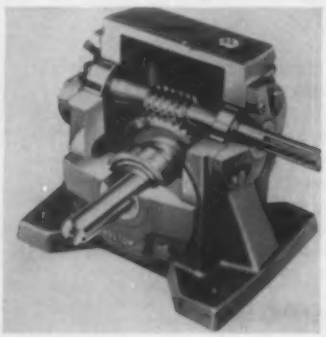
19—HEATING SYSTEM for hot water loads up to 900 gph

The Iso-Therm Hot Water Heating System is claimed unique in its ability to provide a maximum amount of constant temperature hot water with a minimum amount of boiler horsepower available. It utilizes a new technique of constant average steam feed with "offset" cooling water temperature control. The heater is a direct-steam-mixing type and requires no return line. Because of its vertical design it uses only a few feet of floor space. The tank is protected from corrosion by company's Chromasoid lining and a magnesium electrolytic corrosion inhibitor.

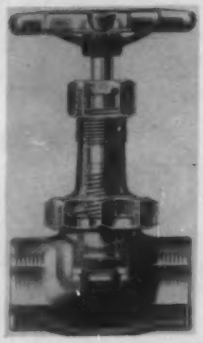
Designed for laundries, dairies and similar plants, this packaged heating system is available for hot water loads up to 900 gph; non-packaged designs are available for loads up to 20,000 gph. Bulletin 920-A gives full information. Fred H. Schaub Engineering Co.

20—SPEED REDUCTION UNITS feature compact design

The 100 Series Reductors are announced as standard stock gear reduction units made in a full range of models and ratings for virtually all drive needs. Compact design and improved worm gearing,



it is said, provide greater load carrying capacity with less weight and less space. Fins on housings improve heat dissipation. Fan-cooling is optional on larger size Reductors, except compound units. Listed outputs are certified by independent laboratory tests. Reductors are available in 52 standard stock models — 283 different units with ratios from 5:1 to 3600:1, output torque ratings from 40 to 9400 in.-lb. Boston Gear Works.



21—BRONZE VALVE utilizes both new material and new design

Leakproof performance claimed for the LQ600 Bronze Valve is attributed to a combination of two new elements. First of these is the seating metal used, an alloy called Brinalloy said to offer superior resistance to wear and corrosion. The other element is the flat-seat design of this valve. According to manufacturer, flat-seat designs have generally been considered impractical for throttling service because many seating materials fail rapidly by wiredrawing; but Brinalloy is so resistant to wear that it can be fused permanently into the valve. Brinalloy seats and discs in the new valve do not require replacement, renewing or regrinding, it is stated. The LQ600 also features a streamlined appearance and incorporates company's Stemalloy stem and Non-Slip handwheel. Circular 602 gives details. The Lunkenheimer Co.

22—PROPORTIONING PUMP is single-revolution type

Uni-Feeder Pumps are company's standard units equipped with a solenoid or air-cylinder operated single-revolution clutch, which in a normal position is disengaged and the motor and gear reducer are always running. When the solenoid or air cylinder is energized, the clutch then becomes engaged, it is explained, allowing the pump to go through one complete cycle for which its capacity has been previously adjusted to provide the exact slug of fluid desired. Energizing of the solenoid or air cylinder is by electrical contacts or by air-sending devices in the bulk line. It may be controlled according to a time cycle, flow, pH, color, concentration or any other meterable factor. Pumps are available with capacities from 0.000093 to 27 gpm. Catalog S-1254 gives more details. Philadelphia Pump & Machinery Co.

23—OIL SWITCH is remote-control type

The Type VR, a heavy-duty, remote-control oil switch, is announced for capacitor switching, distribution feeder sectionalizing, and automatic load transfer applications. It has a 110-kv BIL, a 20,000-amp momentary rating, and a 400-amp thermal rating. It is designed to trip and clear all three phases simultaneously in three cycles. An auxiliary switch that provides flexibility for relaying and signal schemes is available with the VR Switch. Line Material Co.

24—WATCHDOG INSTRUMENT scans many processes

This electronic "watchdog" is announced for testing and controlling continuously an unlimited number of industrial processes from a single vantage point. Called an indicating scanner, the new instrument is designed to monitor a variety of process variables involving level, temperature, thickness, mechanical movements, tolerances, weight and pressure. It keeps a steady check on six, 12, 24, 48 and more steps in a manufacturing process, company states.

Scanning speed depends largely upon number of points to be checked, with a maximum rate of 1 point per second. When a process strays beyond the preset control zone the scanning stops at that point and actuates an alarm or flashes a signal, manufacturer explains, and the indicator dial shows the extent of the deviation. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

25—OXYGEN ANALYZER is simple, portable instrument

For measuring continuously-flowing samples, or for fixed volume samples as small as 3 cc, the portable Model C2P Oxygen Analyzer can be obtained in practically any desired range of 5 per cent or more between 0 and 75 per cent oxygen — and in ranges of 15 per cent or more between 75 and 100 per cent oxygen. Accuracies, in any range, are claimed within ± 1 per cent of full scale, due to the paramagnetic principle upon which the instrument operates. The measurement is a direct physical measurement of the oxygen itself and response is rapid, it is pointed out. The scale is direct reading and may be calibrated in either per cent oxygen or millimeters of mercury oxygen partial pressure.

The Model C2P is designed for rugged service and insulated against shock and vibration. The analysis unit in contact with the gas is made of a corrosion-resistant material. Applications include flue gas analyses, food and chemical processing, checking locations where ventilation is a problem. It operates from standard 115-v a-c power sources, weighs 12 lb. Arnold O. Beckman, Inc.

26—PROTECTIVE COATING for use on thermal insulations

Lagz is compounded from Neoprene and silicone rubbers and other resins to form a coating unaffected by moisture, oils, brine, solvents, corrosive gases, chemicals and weathering. It is said to have high mechanical strength and to protect insulation from damage by abrasion and puncture and affords high thermal efficiency and low maintenance costs. Lagz is also claimed non-flammable and non-toxic and to be an excellent adhesive. It can be used to fasten insulation to surfaces and to cement edges of formed insulation together without use of ties or bands, says manufacturer.

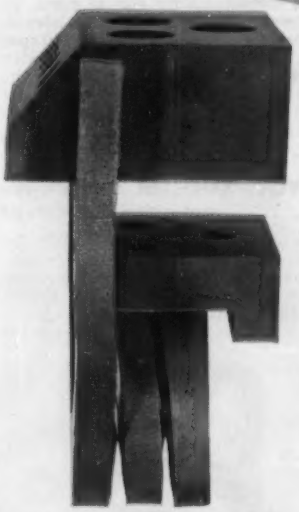
Two grades are available. No. 1, a medium viscosity material, is for use

For more data circle 531 on Post Card

I-T-E SAVES MONEY BY USING

Revere Extruded Shapes

PROBABLY YOU CAN TOO!



Overload device, OD-2, made by I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia, Pa., using Revere Copper Extruded Shapes.

Actuating mechanism, showing overload coil brazed to two Revere Extruded Shapes.

Here is a photograph of the I-T-E Dual Selective Overcurrent Trip, an air circuit breaker part. It contains two Revere Extruded Shapes, in copper. In the detail view, the beveled shape at the top is furnished in Free-Cutting Copper, to speed up the drilling and tapping of the holes. The piece below it was originally milled from rectangular copper bar, 1 x 2 inches. The bar weighed 7¾ lbs per foot, and 1.8 lb of scrap per foot was generated in machining it to the angular form shown. The company then switched to a Revere Extruded Shape, weighing a little less than 6 lbs per foot. Though the shape inevitably costs more per pound than the bar, the reduction in weight was sufficient to save almost 44¢ per foot over the bar, and of course additional savings were realized in reduced machining time and in scrap handling. Production also was speeded up. This is an outstanding example of the economies offered by shapes.

Look into extruded shapes, in copper and copper-base alloys, and aluminum alloys. The nearest Revere Sales Office will be glad to explore the subject with you.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y. Sales Offices in Principal Cities; Distributors Everywhere.

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with 85 per cent Magnesia, calcium, silicate, felt, rock wool, and asbestos. It can be applied by spraying, brushing or sponge. Lagz No. 2, of high viscosity, is for use with low temperature insulation such as cork, foamed plastics, glass fiber, and cellular glass. It is applied by brush or trowel, and described as a perfect vapor barrier. Lagz sells for about $5.00 a gallon. Technical folder and sample are available to qualified power engineers. West Chester Chemical Co.

27—VARIABLE SPEED PULLEY with finger-tip speed control

Ratios up to 3 to 1 at from 7½ to 15 hp are announced for this variable speed pulley which may be installed on new or existing equipment. It changes speed at finger-tip pressure while machinery is in motion, says company, and this feature is of especial value where quick changes are required to compensate for operator ability, corrections for size of parts, or adjustments for temperature or humidity. Used in conjunction with a 1750 rpm motor, maximum horsepower is 10 with the No. 310 VSP base, and 15 with the No. 315 VSP base. An 1150 rpm motor affords 7½ hp and 10 hp, according to base. Lovejoy Flexible Coupling Co.

28—VOLT-AMMETER has shock-mounted movement

Model 749, a lightweight, pocket-size clamp volt-ammeter, has a single, easily-read scale for all ranges and functions, and employs a shock-mounted instrument movement. The instrument incorporates company's Cormag self-shielded

mechanism with spring-backed jewels, which is shock-mounted within the case. This design, it is claimed, safeguards accuracy and enables instrument to withstand service over longer periods. The scale window is of shatter-proof Plexiglas. To simplify reading, a single scale is employed for all ranges and functions which are selected through a thumb selector switch. The instrument accommodates conductors up to 1 in. round or 1¾ by ⅜ in. rectangular. It contains six current ranges of 300/150/60/30/15/6 amp, and three voltage ranges of 600/300/150 v. Weston Electrical Instrument Corp.

29—ELECTRICAL TAPE for general purpose application

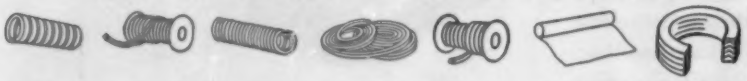
This pressure sensitive vinyl electrical tape features an improved method of bonding adhesive to vinyl that prevents transfer, says company; it eliminates

REDUCE YOUR INVENTORIES, END CONFUSION

WITH R/M's BIG 7 PACKING TYPES

You never see scenes like the one above in plants that have standardized on R/M's Big 7 Packing Types. For this basic line of just seven packing types has simplified the whole packing problem. With it—and you probably need only three or four of the seven types—you can get custom-built performance for all but your very rarest applications. And because you can, you'll lower inventories, simplify ordering, cut investment costs—and greatly reduce any chance of error through wrong selection. To find out in detail how this line can help you, ask your R/M distributor for a copy of the R/M Big 7 Recommendation Chart.

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS



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RAYBESTOS-MANHATTAN, INC.
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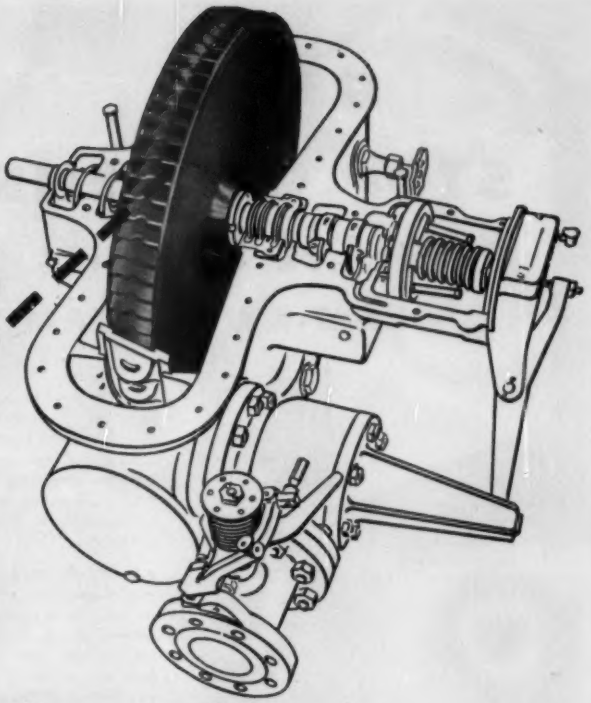
TERRY SOLID WHEEL



..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

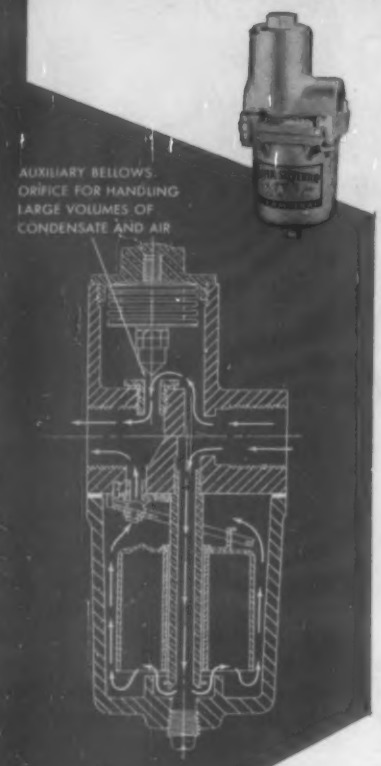
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1197

For more data circle 534 on Post Card

STOP CONDENSATE BACK-UP WITH HEAT-KWIK STEAM TRAPS!



● When production on your steam units fail . . . and you can't get consistent heat in your driers, cookers, kettles, unit heaters, etc., the chances are condensate is backing up into your equipment and cooling it off . . . actually decreasing its efficiency as much as 35%!

● Here's the remedy . . . Whenever you encounter pressure variations on your steam lines, or heavy condensate loads, or the need to vent air quickly, don't depend upon an ordinary steam trap to handle the job even if it has auxiliary air-venting devices. Call on Heat-Kwik traps, having two separate orifices, the conventional condensate orifice and a separate additional bellows orifice. Whenever a heavy load of condensate is encountered, this bellows orifice snaps into action. As soon as condensate hits the bellows, it opens and out goes the condensate in large volumes.

● For maximum efficiency on steam units, do the same as hundreds of other plants, insist on Super-Silvertop Heat-Kwik traps. Your steam units will operate at higher efficiency and at less cost than you ever dreamed possible!

The V. D. ANDERSON Company
Subsidiary of Chesapeake Industries, Inc.
1977 West 96th Street, Cleveland 2, Ohio

WRITE FOR *Bulletin 1153. Tells how to prevent condensate from backing up with new Super-Silvertop Heat-Kwik Steam Traps.*

SUPER-SILVERTOP
HEAT-KWIKS
the Engineered Steam Trap by
ANDERSON

For more data circle 535 on Post Card

objectionable tackiness on backing and provides greater adhesive strength. This suggests its use on hard-to-get-at fixture openings, junction boxes and conduits. The tape is described as thin, tough and resilient. It can be pulled without breaking, manufacturer notes, to make a tightly wrapped splice, reducing the bulk of the finished job.

This tape is suggested for general insulation taping and as a jacketing tape for splicing of power transmission and distribution cable. It comes in 7- and 10-mil thicknesses. The dielectric strength of the former is claimed better than 10,000 v, and that of the 10-mil tape to be in excess of 13,000 v. Both are available in 20-ft, 66-ft and 36-yd rolls and in various widths. Bishop Mfg. Corp.

30—STEEL STEP LADDERS for the higher-up jobs

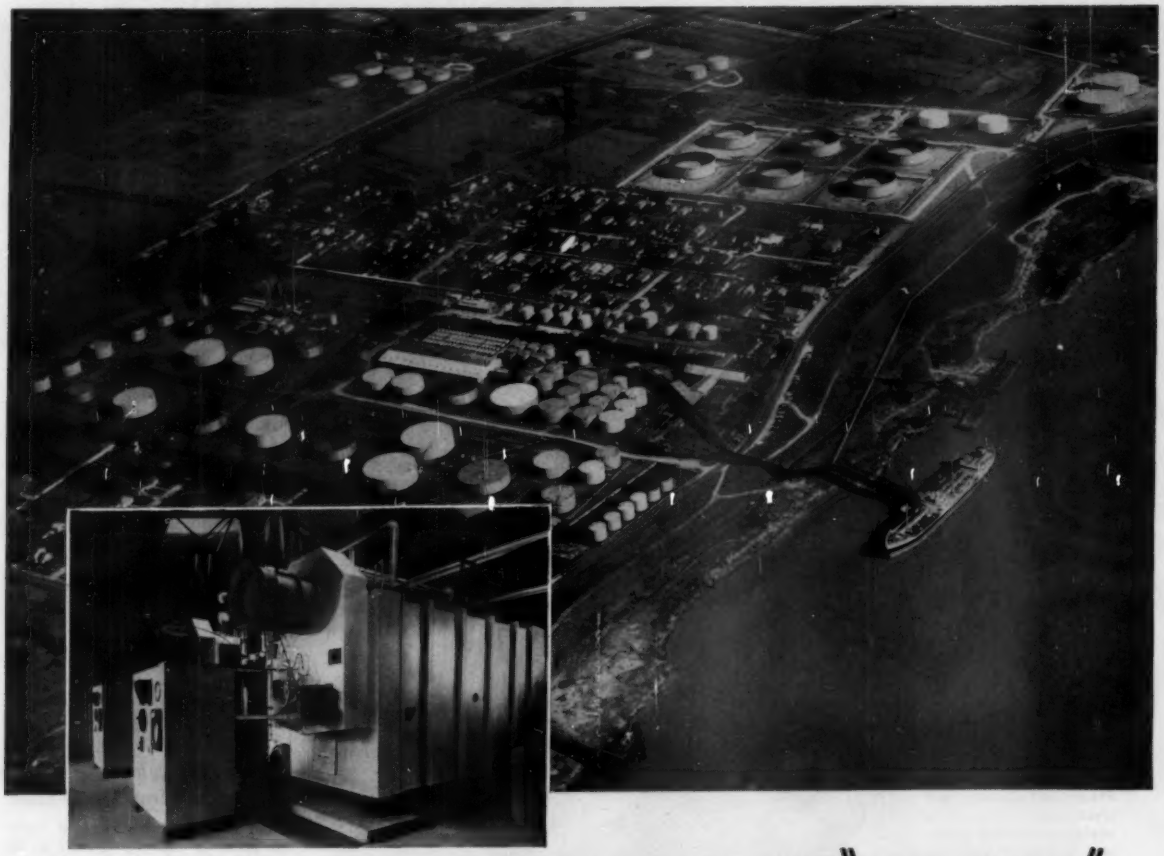
Designed for safety and handling ease, Hi-Boy Safety Step Ladders give accessibility to working levels up to 15 ft. They are offered in six models, from 9 to 12 steps, ranging in height from 85½ to 114 in. Of all-welded steel construction

(frame is ¾ in. steel tubing), for strength and long wear, they are mounted on heavy-duty ball-bearing casters for easy rolling. When moved into position, ladders are anchored to the floor by stepping on a pedal under the front step. This easy action lock causes two front rubber-tipped legs to engage the floor, says company, preventing kick-out and wobbling. All models have guard rails. Non-slip step plates are made of expanded steel tread, grip steel lath or rubber-clad steel plate. The Ballymore Co.

31—AMPLIFIER for low level d-c voltage measurement

Basic instrument of a line of electro-pneumatic and electro-hydraulic measurement and control devices, the Powr-Amp Model P Amplifier is designed to increase the speed and accuracy of practically all low-level d-c voltage measurements. It is suggested for use in power generation, steel production and high temperature processing; and is claimed compatible with inputs from thermocouples, radiation pyrometers, thermal converters, and d-c strain gages. Applications involve temperature measurement and control, telemetering, automation, and d-c preamplification.

Full scale response of this d-c amplifier is listed as better than 0.1 sec, and long-time measurement accuracy at ± ¼ per cent of input range for 5 mv and up. The 9 by 20 by 10 in. instrument is



B&W FM Boilers help keep bulk liquids "on tap"

at General American Tank Storage Terminal

General American Transportation Corporation serves South Central shippers and processors of bulk liquids through its Goodhope, Louisiana, Tank Storage Terminal (one of 6 throughout the country). This valuable national service assures industrial consumers of quick delivery of whatever they want when and where it is needed: Chemicals, Petrochemicals, Petroleum products, Molasses, Vegetable oils. Any liquid that can be transported is always on quick-call—a 48,000 GATX tank-car fleet provides dependable service.

Helping to insure fast delivery from the Goodhope Terminal are two B&W Type FM Boilers. They furnish steam to drive oil-pumping equipment for loading or discharging crude oil for delivery or storage. These gas-fired units supply a total of 48,000 lb of steam per hr. at 235 psi. Other FM Boilers are "working on the railroad", providing steam for heat in railroad stations and shops and heat for rolling stock in coach and marshalling yards.

This is another example of the FM's versatility—a versatility that encompasses power, processing, and heating, for institutions, utilities, industries and agriculture, both indoors and out.

The FM Boiler is available in individual units in capacities to 40,000 lb of steam per hr, with fully automatic control. Listed at right are FM maintenance and cost-saving features that many users are right now enjoying. If you are interested in "package" heating, processing, and power, and their many benefits, send for Bulletin G-76A. Further, we will be glad to discuss with you any details that may be special in your operations. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-695

COST-SAVING FEATURES

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

BABCOCK & WILCOX

BOILER DIVISION

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INSTROF

for the support of instrument tubing

BOX GIRDER—for long unsupported span lengths.

TUBE RACE—for branch run.

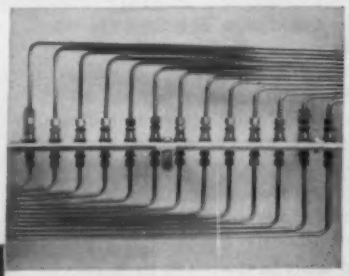
The Instrof System installed in a large South-West Coast Chemical Plant. All fittings are stock items which were rapidly assembled on the job. System is ready for placement of tubing.

Instrof is a system of prefabricated metal trough specifically designed to give continuous support and protection to instrument tubing. It is the most versatile system of its kind on the market today, and can be readily assembled at the job site in an extremely short time. Once installed, it requires no maintenance.

Instrof is available in widths of 3", 6", 9", 12", 18", and 24" with a complete range of fittings for all widths. These fittings enable the system to follow walls, change direction and elevation, and to change from one width to another—in short, to conform to any plant layout.

For further information on how the Instrof System can help solve your tubing problems, write today for the new Instrof Catalog. Ask for Bulletin P-6.

The Instrof Bulkhead Bar is a light section of channel with ¼" brass couplings mounted on 1½" center. It can be used wherever straight or angle tube terminal connections are required, such as junction boxes, panel boards, etc. It is especially adaptable to mounting on Instrof sections. The standard bar contains 40 ⅛" brass couplings and is five feet long. Other sizes can be manufactured to customer's specifications.



INSTROF

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4923 PENTRIDGE ST.
PHILADELPHIA 43, PA.

For more data circle 537 on Post Card

available in multiple fixed and adjustable ranges, with fixed or adjustable zero suppression circuits. Bulletin MSP 111.1 provides data. Hagan Corp.

32—SIGHT FLOW INDICATORS for new or existing pipe lines

Available in transparent two-window and one-window, and in reflex one-window types, are these new indicators for viewing liquid flow. They may be installed in pipe lines from ½ to 2 in. NPT. In these indicators, visibility of liquid flow has been improved by obtaining turbulence through the interrupted bore of the fitting. Several types of indicating vanes may be furnished, according to variable conditions of rate of flow and viscosity of liquid. These are installed within the chamber and show the flow or absence of flow by movement when liquid is flowing. The reflex type indicator is used where the main objective is to show only whether or not there is liquid in the line — when liquid is flowing the glass shows black due to the prismatic window.

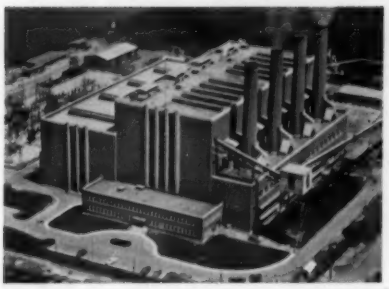
Pressure-temperature ratings vary from 2000 psi at 100 F to 600 psi at 1000 F in the transparent double window types, and up to 3000 psi at 100 F or 1000 psi at 1000 F in the single window or reflex types. Solid wedge type illuminators may be had for use with these flow indicators. Jerguson Gage & Valve Co.

33—D-C VOLTMETERS for panel mounting, linear scale

This line of d-c expanded scale voltmeters for panel mounting is said to be accurate to ½ per cent of input voltage. The meters offer a linear scale which includes only the useful portion of the

scale; the rest has been eliminated to give highest readability. Standard base voltages range from 6.25 v to 230 v, with span that can vary from 4 to 25 per cent of base voltage. Hermetically sealed and rugged models are said to meet military specifications for environmental conditions. Available in 2½ and 3½ in. round or square, 4½ in. round and 4 by 6 in. rectangular models. Arga Div., Beckman Instruments, Inc.

Described on these pages are new and improved products. Use Reader Service Cards on pages 117–118 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.



The Hydro-Electric Power Commission of Ontario

Lever Brothers Limited

Working for CANADA'S LEADERS

Canadian Oil Refineries Limited

Stone & Webster Engineering Corporation, affiliated with Stone & Webster Canada Limited, offers to industries contemplating expansion in Canada, the design, engineering and construction experience of a world-wide engineering organization thoroughly conversant with the Canadian economy and practices.

The Consolidated Mining and Smelting Company of Canada Limited

Cabot Carbon of Canada Limited

The Hospital for Sick Children, Toronto

The Consolidated Mining and Smelting Company of Canada Limited

Molson's Brewery Limited

Dominion Tar and Chemical Company, Limited

Write or call us for information as to how our experience may be of assistance to you.

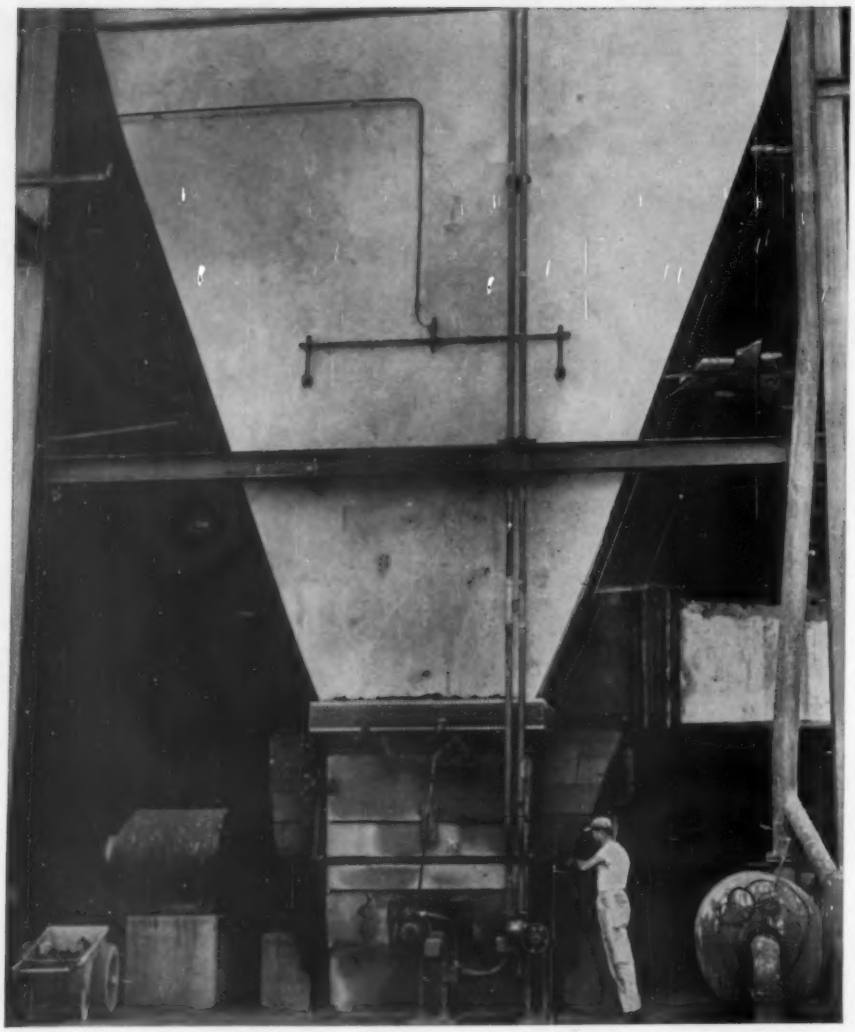
STONE & WEBSTER ENGINEERING CORPORATION

Affiliated with STONE & WEBSTER CANADA LIMITED

New York Boston Chicago Pittsburgh Houston San Francisco Seattle Toronto

BALDWIN-HILL

Super POWERHOUSE CEMENT.....



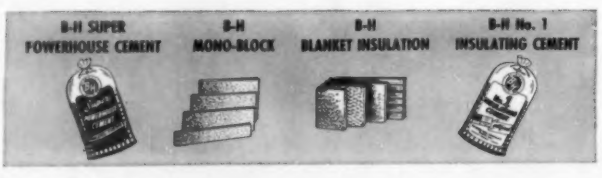
NOW IS.... WHITE

Forced Draft Duct, Fan to Air Heater insulated with B-H Mono-Block, finished with 3/8" B-H SUPER POWERHOUSE CEMENT

Made from the new Baldwin-Hill Spun Mineral Wool fibers, Super Powerhouse Cement dries out *white* to give you a better, more pleasing finish coat. And remember, it requires only one-coat application because it *insulates* as it *finishes.*

Baldwin-Hill
COMPANY

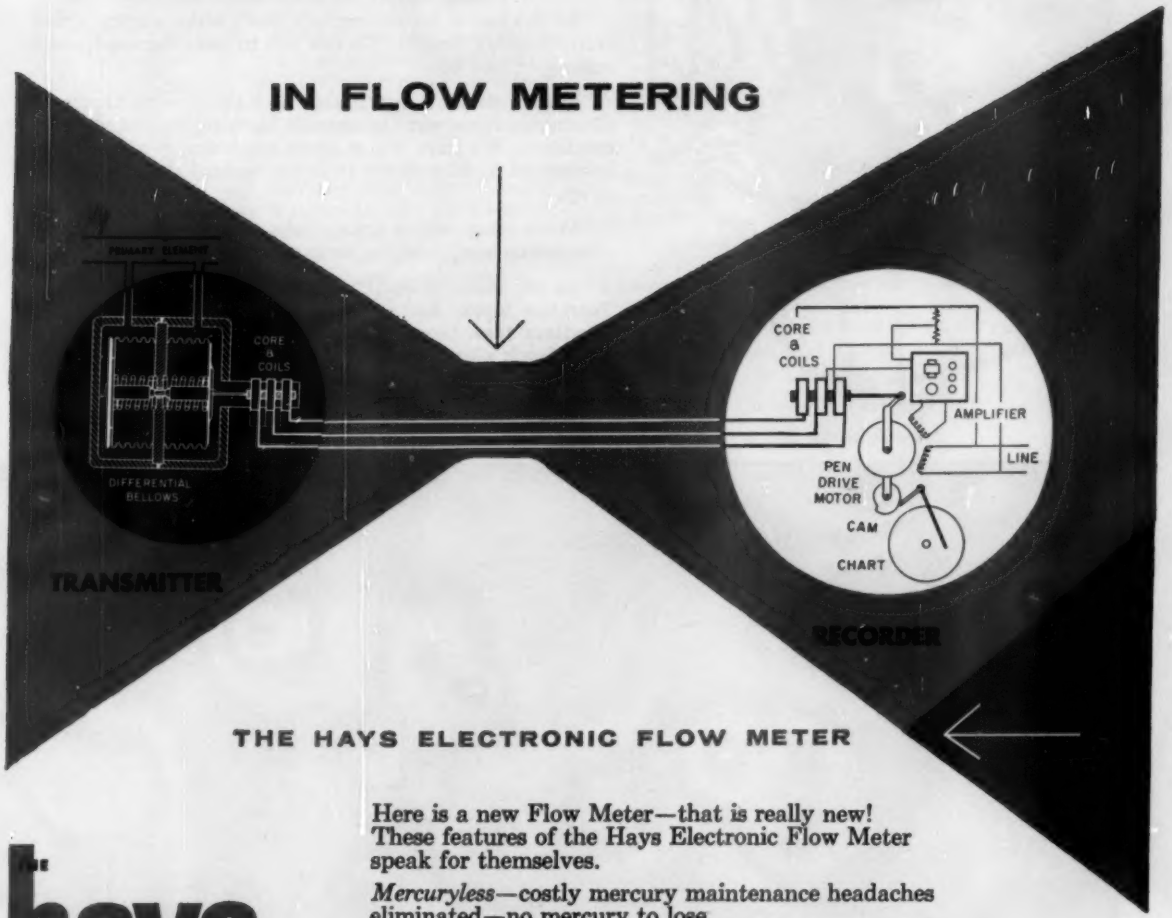
206 Breunig Avenue, Trenton 2, N. J.
Kalamazoo, Mich. • Huntington, Ind. • Temple, Texas



For more data circle 539 on Post Card

new dimensions

IN FLOW METERING



THE HAYS ELECTRONIC FLOW METER

Here is a new Flow Meter—that is really new! These features of the Hays Electronic Flow Meter speak for themselves.

Mercuryless—costly mercury maintenance headaches eliminated—no mercury to lose.

Rupture-proof Bellows—provide positive protection against over-range.

Continuous integration—motor-driven continuous mechanical integrator is extremely accurate even on rapid load changes.

Electronic operation—requires only 4 seconds for full scale pen travel with accuracy of ¼% of full scale differential.

Other features include null-balance transmission, powerful motor, easy readability, accuracy unaffected by normal temperature changes. Explosion proof transmitters and wide range meters also available.

For complete information, write for Bulletin 54-1074-222.

THE **hays** CORPORATION

MICHIGAN CITY 7, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

For more data circle 540 on Post Card

"Our Welding Machines were repeatedly being shutdown . . *until we changed to Fusetron Fuses*"

"They eliminated production losses due to needless fuse blows."

"Our service shop is headquarters for the Detroit area of Fruehauf's operation. Trucks, tractors and trailers come in for repairs.

"As you know, motor carriers don't make money if they aren't hauling freight. It's our job to have the equipment rolling — and fast!

"But we were having trouble with shutdowns. Ordinary 60 ampere fuses were constantly blowing on our welding machines. We have 12 of these machines — that can be connected to 60 ampere switches located throughout the shop.

"Since many major repair jobs require welding, these shutdowns were really a serious problem for us.

"In an effort to avoid these shutdowns, we installed Fusetron fuses. Since changing, there hasn't been any needless fuse blowing on the welders. Fusetron fuses completely eliminated the trouble."

Clyde Parkins CHIEF ELECTRICIAN
Detroit Branch • Fruehauf Trailer Company, Detroit, Mich.

EVERYONE IN THE PLANT CAN BENEFIT BY USING FUSETRON *dual-element* FUSES.

FUSETRON is a trademark of the Bussmann Mfg. Co.,

To Electrical and Safety Engineers
Fusetron Fuses Offer Maximum Safety

The 100,000 amp. interrupting rating of Fusetron fuses is apace with the high capacities of today's network systems — and they are adequately safe to meet future circuit growth.

Fusetron fuses reduce the expense of damaged equipment and the danger of fire and other hazards that can result from electrical faults because — they protect against short-circuits, harmful overloads and single phasing.

To Production Engineers
Fusetron Fuses Offer Increased Production

Down-time is reduced, because Fusetron fuses wipe out needless blows caused by harmless overloads or excessive heating of panels or switches.

HERE'S WHY FUSETRON FUSES GIVE ALL-PURPOSE PROTECTION

A fuse link combined with a thermal cutout — the result, a fuse with tremendous time-lag and much less electrical resistance and an interrupting rating in excess of 100,000 amps.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses, FUSETRON Fuses fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Write for bulletin FIS.

To Maintenance Engineers
Fusetron Fuses Offer Savings in Time and Work

Once properly installed, Fusetron fuses require no periodic inspection or down-time necessary on mechanically operated devices.

They protect against irritating interruptions of regular maintenance caused by needless blows. Unnecessary repair work is reduced because — if trouble occurs, Fusetron fuses open and warn of danger before motors or equipment are damaged.

Panels and switches are protected against damage due to poor contact heating.

To Top Management
Fusetron Fuses Offer Reduced Costs

Fusetron fuses cut maintenance costs because they are maintenance free — they increase life of equipment by guarding against damage caused by electrical faults — and they lower production costs by eliminating shutdowns due to needless blows.

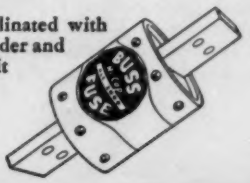
They save waste of space and money by permitting use of proper size panels and switches, instead of oversize.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS . . . USE BUSS HI-CAP FUSES . . .

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.



Play Safe! install Fusetron and BUSS Hi-Cap Fuses throughout the entire Electrical System.

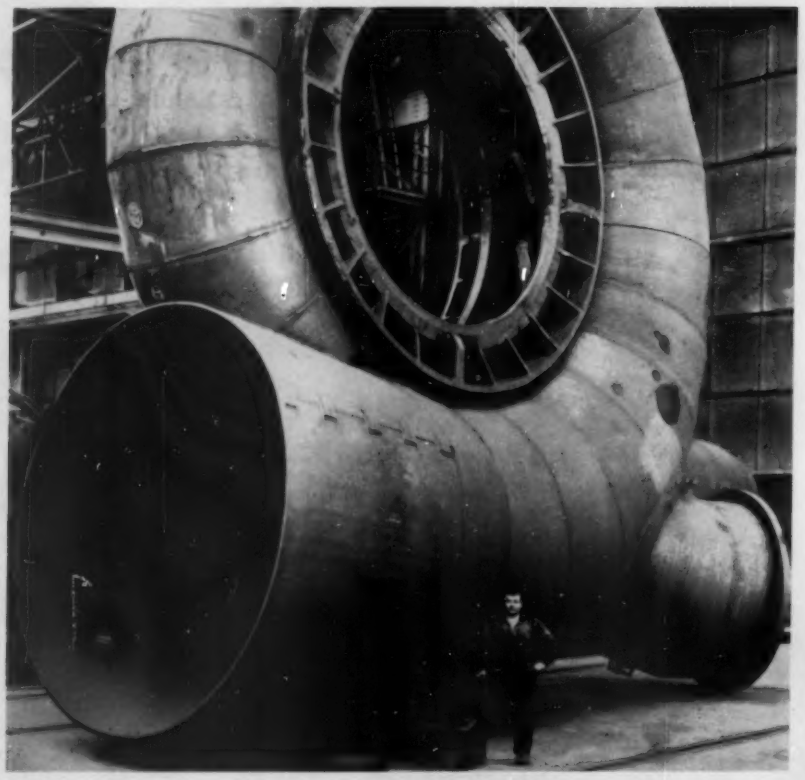
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN MFG. CO. (Division of McGraw Electric Co.)
UNIVERSITY AT JEFFERSON ST. LOUIS 7, MO.

For more data circle 541 on Post Card

News Reel

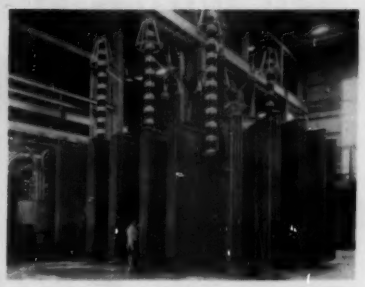
Cowboy/waterboy on the Daley Ranch down Florida way. At only 12–14 in. above sea level, *getting rid* of water was the big problem. A 40,000-gpm pump and a 15,000 gpm pump, both diesel-driven, keep 1500 acres dry



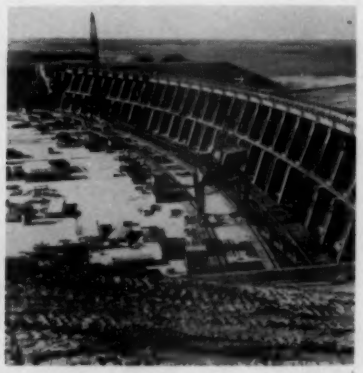
Great Britain is in the export business in a big way these days, as is indicated by this king-sized hydraulic turbine casing for Portugal. Made by the English Electric Co., this is one of two 73,000-hp units being exported to that country

Main speakers at ASME gas turbine session at Baltimore: (l to r) John Culver (Bu Ships); Amos Wood (Boeing); Roland Coit (Westinghouse); and Ivan Swatman (Solar). It is interesting, and perhaps significant, to note *not a gray hair in sight*, but plenty of know-how

(Below, left) No noise aloud! Engineer working on GE's sonance design program checks sound characteristics of one of company's newest motors inside the anti-echo chamber. Sound origin is located more easily without echoes



Joppa's new 56,000-kva current-limiting reactor (GE's largest) will be tie between two 161-kv buses. Oil-immersed, reactor unit has 22 radiators

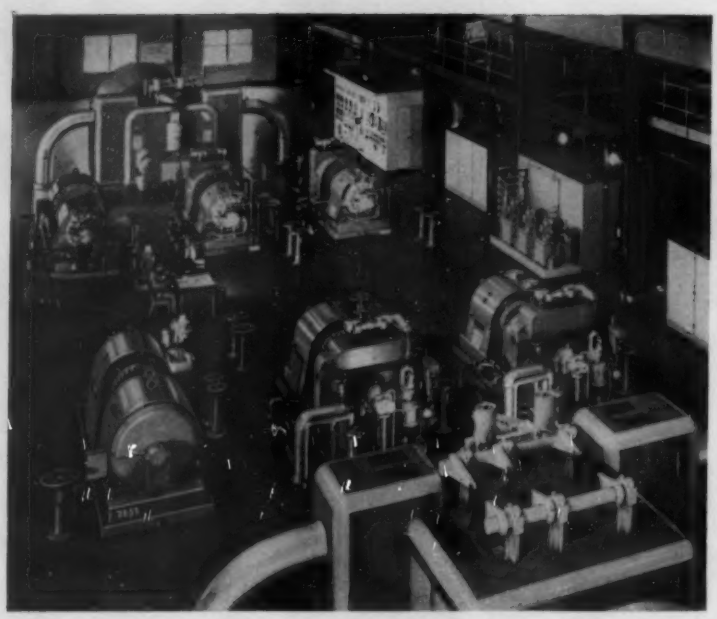


Garrison Dam Spillway should be completed by August 1955, if present rate of progress is maintained. It sports 28 fifty-ton gates, each 40 ft by 29 ft

Patience and skill are obvious requirements in the making of foundry patterns of this size. Eventually this will be the exhaust section of a large Westinghouse steam turbine, but only after a few thousand more hours of close work

Down on the Ohio River, TVA's Shawnee steam plant uses a 2640-ft conveyor to get its coal from the river to crusher house. Barge at lower left is being unloaded by clamshell. Cooling water intake at left, discharge right

What makes a barrel-type boiler feed pump *stay in service?*



Here are some of the design features that assure dependability

Today's modern multi-stage centrifugal pumps for boiler feed service are the result of years of research and design. To provide efficient service *plus* dependability, De Laval has incorporated these important features in its barrel-type pump.

Double Volute Diaphragms

Double volute diaphragms provide for radial hydraulic balance and assure a continuous rising head characteristic from the design point to shut-off. *RESULT—Higher efficiencies are maintained over a wider range of operation than are generally obtained with other forms of velocity pressure conversion.*

Individual Diaphragm Bolting

Elimination of rabbet fits and gaskets permits straight metal-to-metal contact of adjacent lapped faces of the diaphragms which are individually bolted together to maintain tight joints and ease of assembly. *RESULT—Positive assurance against inner case leakage, complete elimination of misalignment causes and a minimum of distortion from sudden temperature changes.*

Positive Sealing Between Suction and Discharge Chamber

Inner assembly is held at the inner high pressure joint at the suction end of the barrel, against a flexitallic gasket, with through bolts. The joint between the suction and discharge chambers is made tight during assembly—remains tight whether pump is operating or idle. *RESULT—No possibility of leakage or gasket loosening due to changes of force on the inner joint.*

Bare Shaft

Bare shaft construction with split ring-shrink fit method of impeller mounting permits a scalloped shaft design and eliminates the need for spacer sleeves between impellers. *RESULT—Better hydraulic conditions at the eye of the impeller and elimination of spacer sleeves—the greatest cause of shaft warpage.*

Wearing Rings

Diaphragms and impellers have renewable wearing rings. Impeller rings are threaded on the impeller hubs against rotation, and diaphragm rings are held by a breech lock fit in the diaphragms. *RESULT—Construction permits renewal of original clearances without major part renewal or modification. Labyrinth type diaphragm ring results in minimum leakage over a longer period of time than with close clearance flat rings.*

IMO Oil Pump

A De Laval IMO pump designed for high speed operation is direct-connected to the outboard end of the barrel pump shaft, and is sized to lubricate both pump and driver bearings. *RESULT—Quiet, pulsation-free, positive displacement IMO pumps, assures positive lubrication and eliminates the need of extra shaft length and mechanical complications required by gear drive lube oil pumps.*

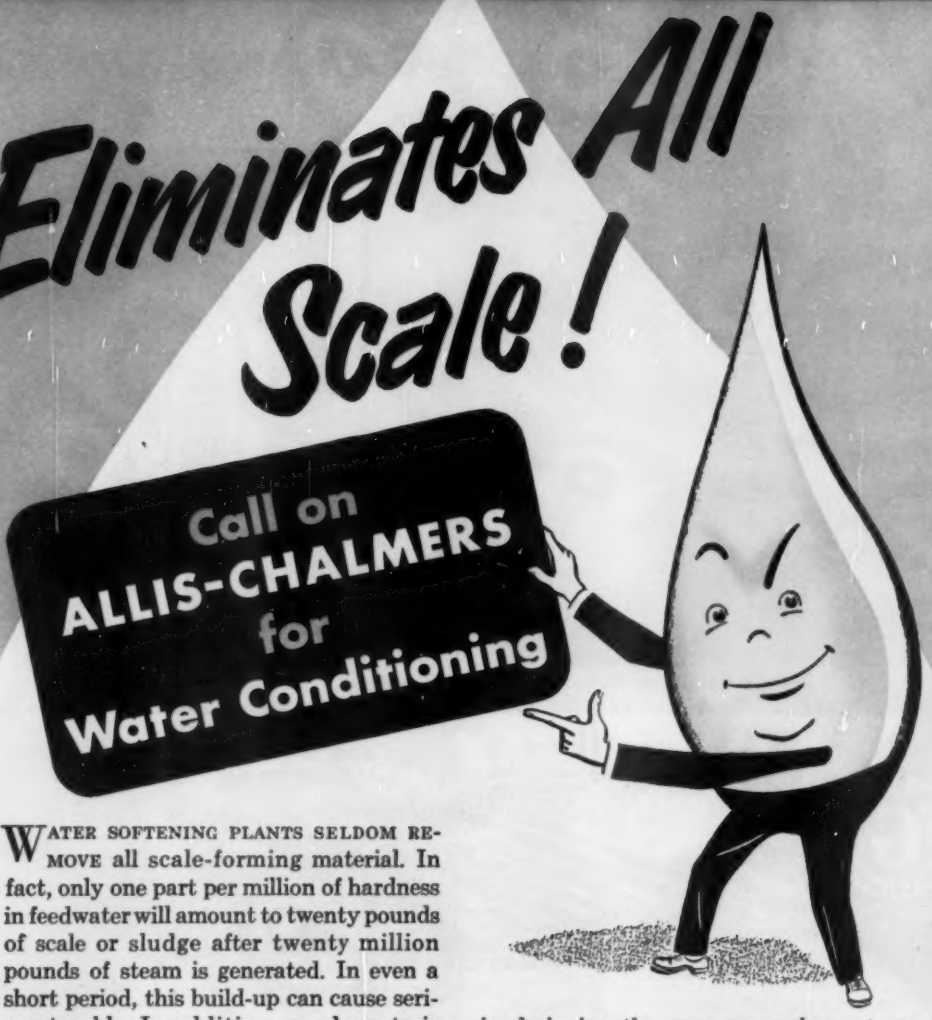
BULLETIN CONTAINS HELPFUL DATA

This De Laval bulletin on the barrel-type boiler feed pump covers all major design points . . . has cross-section cut-away illustration for easy reference. Write on your business letterhead for your copy of Bulletin 1506 to De Laval Steam Turbine Company, 816 Nottingham Way, Trenton 2, New Jersey.

For more data circle 543 on Post Card

Allis-Chalmers Supplementary Treatment

Eliminates All Scale!



WATER SOFTENING PLANTS SELDOM REMOVE all scale-forming material. In fact, only one part per million of hardness in feedwater will amount to twenty pounds of scale or sludge after twenty million pounds of steam is generated. In even a short period, this build-up can cause serious trouble. In addition, condensate is frequently contaminated.

To solve this problem, Allis-Chalmers has developed its supplementary treatments, which are formulated specifically to the requirements of individual plants.

You can find out about factors involved in designing the proper supplementary treatment in Allis-Chalmers Water Conditioning Informational Bulletin 52. It explains how Allis-Chalmers water conditioning engineers approach this problem. Get a copy from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wis.

A-4594

ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT, SERVICE—FOR OVER 25 YEARS

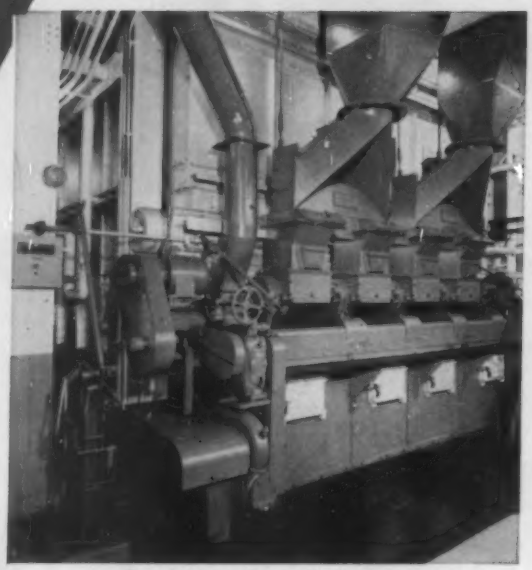
A-C ALLIS-CHALMERS

For more data circle 544 on Post Card

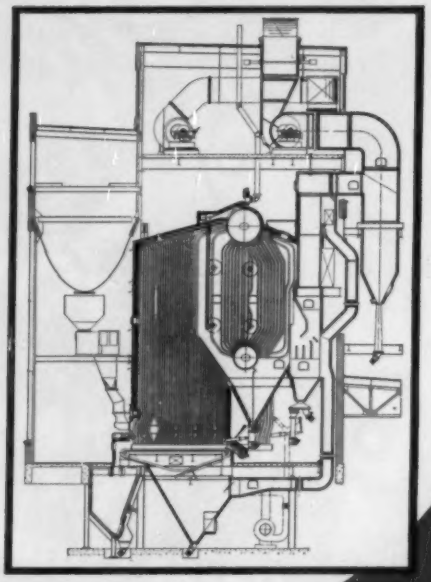
Detroit RotoGrate Stoker

SELECTED FOR TIRE PLANT

The B. F. Goodrich Company, Oaks, Pa.



Detroit RotoGrate Stoker in
B. F. Goodrich plant at Oaks, Pa.



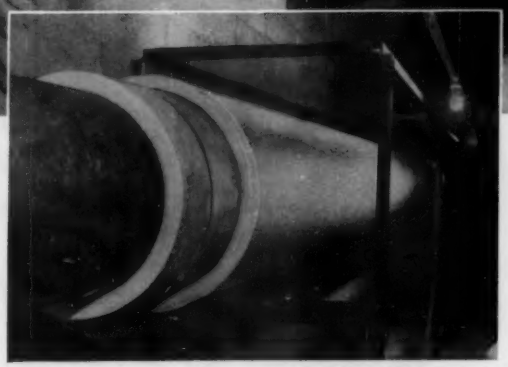
This Detroit RotoGrate Stoker is installed with a Wickes two drum Steam Generator, capacity 115,000 lbs. per hour at 300 psi and 440° F. Design is based on using 350° F preheated air, when burning Fairmont District West Virginia coal. This is part of an expansion program at this plant. Detroit RotoGrate is an advanced spreader stoker with specially designed overlapping grates that move slowly forward, discharging ash at the front. Any Bituminous coal or Lignite, and many types of refuse are successfully burned. High burning rates per square foot of grate and exceptional flexibility make this stoker popular. Detroit RotoGrate will save you money—improve your operation.

DETROIT STOKER COMPANY
GENERAL MOTORS BLDG.—DETROIT 2, MICH.
District Offices in Principal Cities • Works at Monroe, Mich.

DETROIT SINCE 1898 STOKERS

7106

For more data circle 545 on Post Card



SNAP*ON...

the modern, efficient way to insulate pipe

Take a good look at the unique one-piece glass fiber pipe insulation that insulates a 6-foot section of pipe as quick as you can say "Snap*On!" Then picture the savings in your plant when you put Snap*On on large or small, hot or chilled piping.

These on-the-job photos were taken at a midwestern university where large steam distribution lines in tunnels were recently insulated with Snap*On. The job was done in remarkably short time because of the exceptional ease of application. Workmen were pleased to discover that Snap*On weighed only 1/10 to 1/4 as much as conventional insulations—yet was so fibrous-tough that there was no breakage . . . no mess . . . no clean-up time.

An important secondary saving was the heat saving. Tests conducted on the finished job by the university showed the surface temperature of Snap*On to be 50° lower than that recorded on the insulation formerly used!

These are documented facts. The same sort of superior thermal efficiency and low-cost application can be yours if you insulate piping up to 33" in diameter, where temperatures do not exceed 350°. But see for yourself—write today for samples and Technical Bulletin SO-55 today.

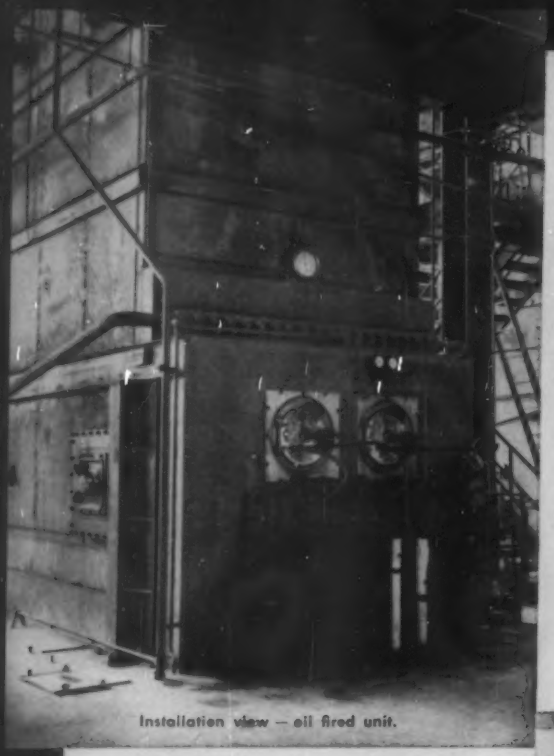
GUSTIN-BACON *Manufacturing Company* GUSTIN gb BACON

Thermal and acoustical insulations • Molded glass fiber pipe insulation • Pipe coupligns and fittings

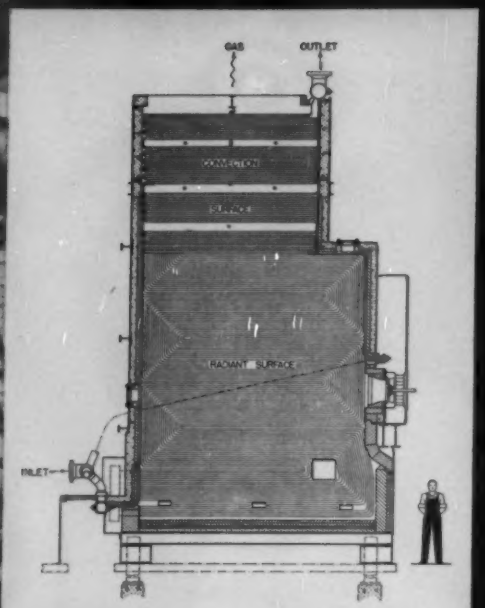
250 W. 10th STREET KANSAS CITY, MISSOURI

For more data circle 546 on Post Card

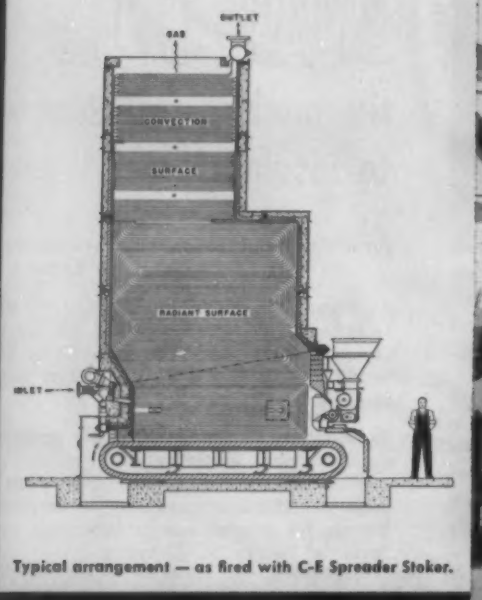
C-E LaMont Controlled Circulation Hot Water Boilers



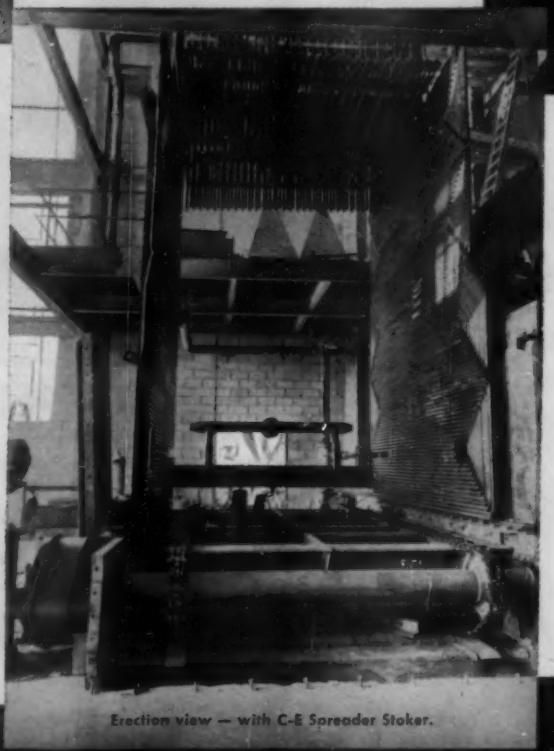
Installation view — oil fired unit.



Typical arrangement — as fired with oil or gas.



Typical arrangement — as fired with C-E Spreader Stoker.



Erection view — with C-E Spreader Stoker.

Ever consider High Temperature Water for your heating and processing needs?

Both steam and high temperature water have their place, and your particular requirements will determine which is best for you. In either case the complete C-E line includes a type and size of boiler exactly suited to your requirements. Where high temperature (HT) water seems indicated, it affords such important advantages as:

1. **The higher available heat in HT water . . . many times that of steam at the same pressure.**
2. **Closer control of temperatures throughout the system.**
3. **Heat loss is minor with the HT water closed system . . . no condensate losses . . . unused heat returns to the boiler.**
4. **No elaborate feedwater treatment required because make-up requirements are small.**
5. **No steam traps are needed, which means elimination of all trap problems and attendant expense.**
6. **No blowdown losses . . . no safety valve vent losses . . . no condensate return lines.**

The planning of any new heating and/or processing system should give proper consideration to the suitability of the HT water system. There are many hundreds of HT water installations operating abroad and a rapidly growing number in the U.S.A. It may be *just right* for *your* requirements.

B-831

Advantages of the C-E Hot Water Boiler

Once it is established that HT water is right for your needs, your next concern is selection of proper equipment. The C-E LaMont Controlled Circulation Hot Water Boiler has inherent advantages that make it the best possible choice. It is especially designed for HT water applications utilizing as it does the principle of forced, controlled circulation which is extended throughout the entire system. This accounts for numerous points of superiority in the C-E LaMont Hot Water Boiler. Among these are:

1. **Complete control over HT water movement in both system and boiler.**
2. **Low pressure loss is inherent so no separate boiler pump is required.**
3. **Pressurized operation with oil or gas means no induced draft fan — simple stack.**
4. **Single-pass design — no baffles . . . low draft loss . . . cleaner boiler.**
5. **More efficient heating surface can be arranged because of positive, controlled circulation.**
6. **Other features such as: steel enclosed setting — few headers, all accessible — any fuel, oil, gas or coal.**

The C-E Hot Water Boiler is available in sizes ranging from 15 to 200-million Btu per hour, or more, with pressures up to 300 psi and temperatures to about 425 F.

If you are in the market for a heating or process system — or expect to be — by all means investigate high temperature water and the C-E LaMont Hot Water Boiler. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our new catalog HT-111.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

For more data circle 547 on Post Card

Why does this packing outwear others in cold liquid service?
Because J-M NAVALON contains and retains more lubricant!
Johns-Manville
NAVALON PACKING

. . . and NAVALON® is made of Ramie, nature's strongest fibre

J-M Navalon gives more value because it outwears other high quality packings in cold liquid service. Made by an exclusive process, it contains more lubricant to start with and retains more lubricant in service . . . resulting in less wear on equipment and longer packing life. Navalon has other unique features, too. It resists rot and mildew . . . its strength actually increases when wet . . . the result: fewer shutdowns for repacking.

That's why Navalon is widely used to seal against fresh or salt water, brine, cold oils . . . and many other cold liquids. It has an excellent record of service on pumps, elevators, accumulators, reciprocating rods and plungers, stern tubes and rudder posts of ships. Available in full range of sizes, in styles 190 and 245 for industrial use, style 175 for marine use.

Your J-M Packing Distributor carries complete stocks of J-M Navalon and other high quality Johns-Manville Packings. He can help you choose the right one for your application. Call him for complete information or address Johns-Manville, Box 60, N.Y. 16, N.Y. In Canada, 199 Bay St., Toronto 1, Ont.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

For more data circle 548 on Post Card

What are the men doing?

They are retubing the fuel economizer.

What happened to the old tubes?

Sulphuric acid ate holes in them.

Who put sulphuric acid in the fuel economizer?

Well, nobody meant to. But there was too much sulphur in the coal and when the coal burned some of the sulphur was turned to sulphuric acid.

Why did they purchase the high sulphur coal?

It figured out cheaper on the cents-per-million-BTU basis.

But was it really cheaper by the time they put the new tubes in?

No, it wasn't! And this instance shows that BTU cost is not the only factor to be considered in buying fuel. It's a matter of matching fuel to use and to equipment, and that requires close cooperation between the plant engineer and the purchasing agent.

P.S.

There's a lot more to buying coal than the cost per ton. For facts and figures to solve your particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

For more data circle 549 on Post Card

it's **boiler check-up** time!

HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

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YARWAY blow-off valves

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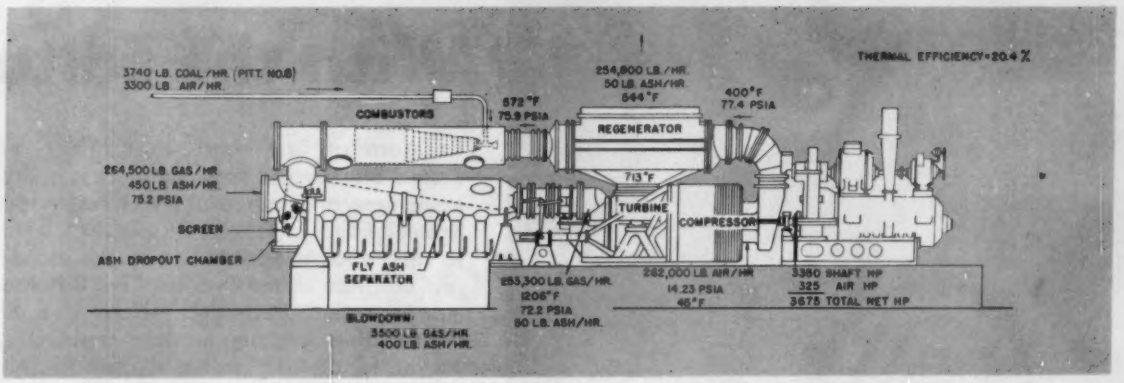


Fig. 1. Side elevation of coal-burning turbine with the 1955 combustion and ash separation equipment on typical test run

Coal-Burning Gas Turbine Progress

Though not efficient by diesel standards, the coal-burning turbine makes very efficient use of the dollar. Latest progress report is encouraging in that biggest problem (fly ash) seems to be solved

MANY YEARS have passed since the industrial world was first informed of serious developmental activity in the field of the coal-burning gas turbine. Such a prime mover held so much promise for economical and simplified power generation that interest immediately hit a peak and stayed there. Surprisingly few have lost interest during the years of problem-solving that followed, and which seem destined to continue for a while.

Since January, 1953, the project has been co-sponsored by the Locomotive Development Committee and the American Locomotive Co. Their interest in such a project can be readily understood. Work during 1953–54 included: (1) A study of suitable, economical coal supply for a locomotive unit; (2) The design, construction and installation of an improved fly ash separator; and (3) Reblading the first four rows in the turbine to improve accuracy of erosion measurements after installation of new ash separators.

Easily-machined 19-9-DL replaced the original S-590 blade alloy, so the turbine was re-rated down to 3540 shp (at 80 F inlet), 5400 rpm, and 1250 F turbine inlet temperature. Vibrations in the generator developed over 4500 rpm, so it was decided to expedite coal-burning tests at this lower speed. Pocahontas coal was burned on the subsequent 300-hr test, at the end of which no erosion or ash deposits could be found. The new ash separator had proved quite satisfactory. This is the most critical single element in the entire project, hence very substantial progress has been reported.

Generator unbalance was corrected and the turbine reassembled for a further test at 5400 rpm, which began January 15, 1955. This time the fuel was a high-volatile (Pittsburgh No. 8) coal. Test running was interrupted by a labor strike, but the 1955 program to April 2nd had accumulated 443 hours at 3280 hp (92.6 per cent of rated load).

The 1955 tests thus far include non-stop runs of 16:02, 22:31, 26:39, 41:12, and 43:55 hours. Average load during this series was 3400 hp (96 per cent of rated load). The average specific coal rate was just below one lb coal per hp-hr, for an average thermal efficiency of 20.8 per cent.

Fine, aerated coal is now being considered as fuel, primarily because of its low price at the mine (about 15 cents per million Btu). Studies on air conveying, fluidized storage, and general behavior of relatively coarse coals are now being conducted. If the expected results are obtained, and the rest of the turbine and separator tests are as expected, we may soon see locomotives burning only $32 worth of coal where comparable diesel units would burn $75 worth.

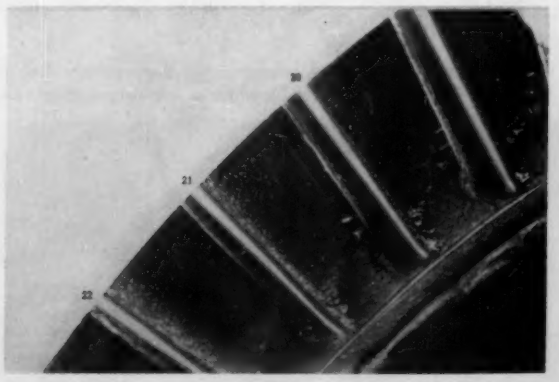


Fig. 2. First row stator after 743:57 coal hours; 300 hours were at 48.4 per cent load, 443 hours at 92.6 (ave.) per cent

Fig. 3. Turbine rotor after the 300-hr test at 48.4 per cent rated load. No measurable erosion or ash build-up detectable

With the Editor

To learn at first hand what effect an atomic blast would have on electric utility equipment and industrial structures, Andy Kramer, Editor of POWER ENGINEERING, went to Las Vegas in April to witness the atomic test program of the Federal Civil Defense Administration. Repeated delays due to unfavorable weather made it impossible for us to present post-shot data in this issue. This will be given next month. Here, however, we present excerpts from Andy's first dispatches, giving his impressions and brief description of set-up at Yucca Flat

Fig. 1. The Editor posing 4700 ft from ground zero. The 500-ft tower carrying the atomic device can be seen behind the sign

LAS VEGAS, Nevada, April 25. As you people back home probably learned from the newspapers, we received our first 24-hr postponement of the test this morning. I rather expected it, though *here* one always expects the impossible. I find that you cannot expect any more from the meteorologists than you can from the gentlemen who operate the gambling tables. Even as early as Saturday, when we received our first briefing, the long-range weather forecast left us with doubts but, of course, in the brilliant sunshine and warm weather it is easy to doubt the dire predictions of the weather boys. But they proved right.

By the way, tell Ray Hagenmiller the sad news. I lost the 2-bit piece he gave me, when I left, in one of those one-armed bandit things. Of course, I knew I would and should have spent it for a drink but I was honor bound to put it in the machine.

Despite the sadness here as a consequence of the delay, it is extremely interesting and exciting. There are some 2000 people here — mostly Civil Defense people, but we also have all the press, radio and TV gang. Not many technical editors.

The pre-shot trip to the site (Yucca Flat) on Sunday, was a big event. We had 16 big Greyhound buses; that will give you an idea of the size of the operation. It is some 75 miles from Las Vegas to the site, and when we arrived there, we were first taken to Observation Hill which is just seven miles from *ground zero*. The 500-ft tower on which the atomic device (it is never called a bomb out here) is located, looked much nearer than that, but later when they drove us to the forward areas, we realized that it *was* seven miles. Distances are vast in the desert and the tower — as high almost as the Washington Monument — sticks out like nobody's business. And that's exactly what it is — nobody's business. We got as far as the 4700 ft line and that is where we stopped. Anything ahead of this line is restricted — military.

This, however, was no hardship. We could see all we wanted behind that point, and there was plenty to see. The more flamboyant newspaper boys refer to this line as "terror town" — the test village of homes, industrial buildings, public utility equipment and communication structures. There is even a big punch press set up behind the two-story brick house . . . It was a bad day yesterday in the desert — high winds, blistering sunshine, and dust storms. We were a dirty, windblown and sunburned lot when we got back to Las Vegas and it took a lot of bathing, and cleaning of cameras to get the dust out. There were no restrictions on photographs — we could take all the pictures we wanted, and I took about everything in sight — even the lovely female dummies sitting around the houses. I felt like Mickey Rooney in the "Atomic Kid."

The houses, the industrial structures, the big punch press, the electric utility equipment were interesting to see in view of what will happen to them on shot day, but always one's eyes return to the slender steel tower that stands in the exact center of that 1200-ft circle of black macadam. At the top is the forbidden house in which the atomic *device* is installed. We know the enclosure is packed full of electronic instruments, and we also know that in the first few thousandths of a second all this equipment, all the coaxial cable, the steel tower itself, and the elevator shaft which serves it will be vaporized.

This thought is intriguing and because of it the tower holds your interest . . . Before all this equipment is converted into incandescent vapor (300,000 C), the instruments will do their stuff. They will make

Fig. 2 (Below). The long vigil. We had a wait after we arrived at Observation Hill and the nights were cold

Fig. 3 (Below). These brave young ladies sleep calmly despite the fact that the blast will blow them into bits—of plaster

At the Yucca Flat Atomic Test

their first, last, and only report, the report of what occurs in the first few millionths of a second. At the same time, hundreds of automatic cameras on the outside will record in detail what happens to the structures, the transmission towers, the transformer substations, the switchgear, and the mannequins.

The pictures I am sending are of scenes both at Observation Hill and at the site at Yucca Flat. The transmission tower and substation equipment were provided by the Edison Electric Institute and associated companies, working in coöperation with the FDCA. There are two identical systems, one at the 4700-ft line, and the other at a distance of 10,500 ft from ground zero. These are associated with the two main residence distribution lines and are based on transformer substations of the kind found in most communities. On one side are typical 69-kv steel transmission towers, on the other side are typical residential distribution pole lines. Parts of the system will be operating at partial power during the detonation.

As far as we can tell, this is going to be a big shot — at least 25 kilotons (equivalent TNT) and probably around 40 kilotons. This will make it twice as big as either Hiroshima or Nagasaki, also Bikini (1946). It will release radiation equal to that from some ten million tons of radium. This is almost unbelievable.

I hope you will print the picture of the two beautiful girls asleep in their beds which I am sending. I really felt this picture was something of an achievement. Just as I was taking the picture some guy who happened to be in the room yelled, "Hey, wait a minute and I'll pose with 'em." "Keep your shirt on," I yelled back — "this picture is for POWER ENGINEERING. It's got to be respectable."

Keep your fingers crossed. I hope there will be no further postponements. *Andy Kramer*

Fig. 5. The electric utility equipment on the 4700-ft line. In the foreground is the 69-kv transmission tower feeding the transformer substation at the left

Fig. 6. A view of Yucca Flat with some of the 2000 FCDA observers in the foreground

Fig. 7. The two-story brick house and the low-voltage wood-pole distribution line residential

Fig. 4 (Below). Always, one's eyes return to the slender steel tower far out there on the desert. It has a fatal charm

Fig. 8 (Below). Another view of the brick house on the 4700 ft line with the punch press placed behind it

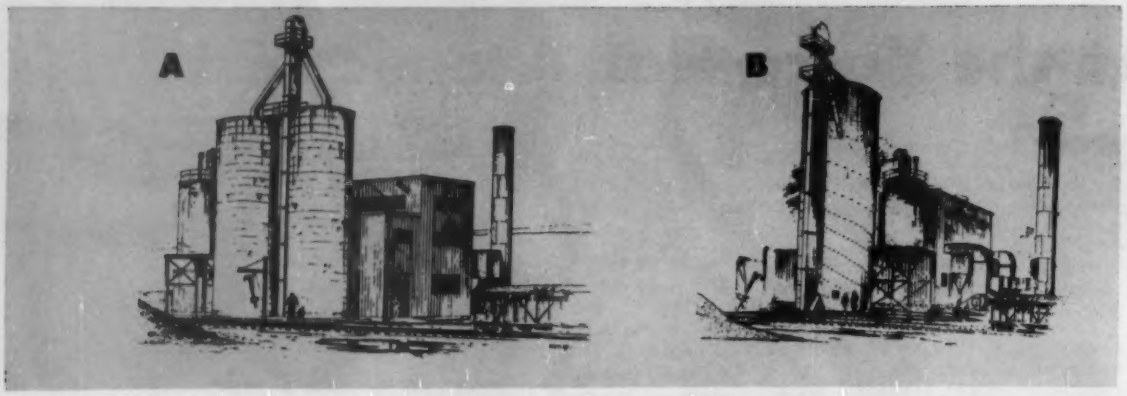


Fig. 1. Two pre-engineered coal-burning steam plants, designed for expansion. Plant A has two 35,000 lb per hr units; B boasts two 60,000 lb per hr boilers

What Two Small Industrial Steam Plants Cost

How much does a small steam plant cost? That depends on the size of the boilers, provisions made for future expansion, degree of automation, and desired operating costs. Read this shorty for ideas

IN A RECENT paper delivered before the ASME, T. D. Coyne of Gibbs and Hill Consultants pointed out the need for well-engineered coal-burning plants comparable to the package boiler installations developed for oil and gas fuels. His company developed designs for two such plants, both providing for expansion.

One of the plants (Plant A) is based on initial installation of two 35,000-lb-per-hr boilers with provisions for a third identical unit. This plant cost $7.19 per lb of steam (hourly), but the over-all cost dropped to $6.20 per lb of steam when the third unit was installed. The second design (Plant B) was for initial installation of two 60,000-lb-per-hr units and provisions for a third. Costs in this case were $6.88 per lb steam for two units, which dropped to $6.31 per lb steam when the third 60,000-lb-per-hr unit was installed.

Both plants were laid out in such a manner that no basement was required, and essentially all drainage is accomplished by gravity. Either plant can be operated by one fireman per shift, with an extra day man to unload coal, clean up and lubricate. Operating equipment is centralized to achieve this manpower economy.

Specifications for both plants call for spreader stokers. Plant A has power-dump-type grates, while Plant B uses continuous-discharge grates. Pressures range between 200- and 260-psig for the specific designs reported, but higher pressures would be easily accommodated. Plant B, with an economizer, would attain 84 to 85 per cent efficiency, while Plant A would operate at 78 to 80 per cent.

Coal-handling equipment for each plant was sized to handle the ultimate three-boiler requirement. Extra capacity permits rapid handling of "bunched" shipments without working overtime. Extra capacity built into the steel stack also permits installation of the third boiler without adding another stack.

Ash collection for these "package plants" consists of vacuum-type ash conveyors, outdoor ash storage bins (to be emptied twice weekly), and mechanical fly ash collectors. Fly ash is reinjected. Over-all collection efficiency is predicted at 93 per cent.

Forced- and induced-draft fans are driven by a common steam turbine and the exhaust steam is used for feedwater heating. Boiler feed pumps are turbine-driven (one for each boiler), and a motor-driven spare pump provides starting and low-load (summer) operation to avoid wasting steam to the atmosphere.

While the plants discussed here are not spectacular in any way, they strike the editors as economical, well-designed installations.

Tables of estimated costs for two small boiler plants, each with provisions for two boilers now, a third later. A has two 35,000 lb units. B has two 60,000's

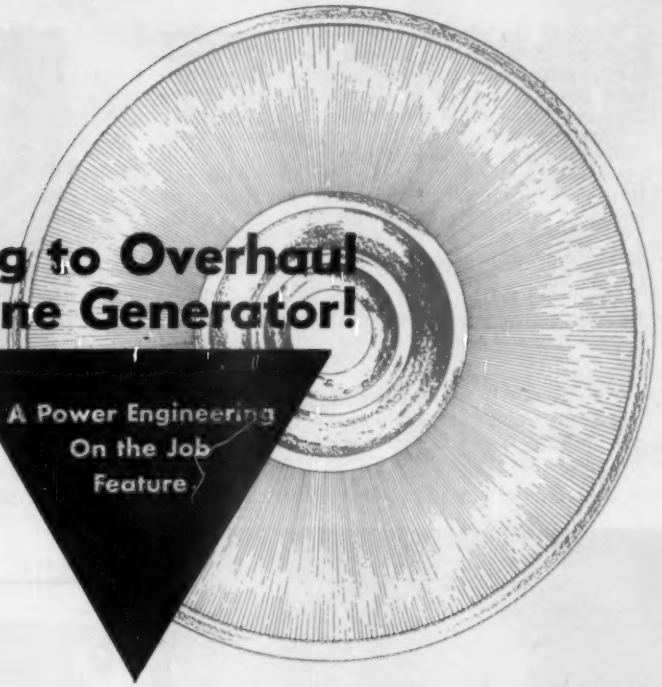
A

	Material	Labor	Totals
Building Foundations	$ 4,520	$ 2,780	$ 7,300
Building Superstructure	32,120	19,435	51,555
Boilers and Firing Equipment	121,615	2,010	123,625
Controls and Instruments	9,500	1,500	11,000
Mechanical Draft Equipment	20,800	1,900	22,700
Dust Collectors, Breeching and Stack	14,250	4,780	19,030
Coal Handling System	35,915	9,755	45,670
Ash Handling System	12,035	6,575	18,610
Feedwater System (Zeolite)	17,790	3,820	21,610
Piping	40,300	21,200	61,500
Electrical Work	3,000	3,400	6,400
Direct Field Overhead Expenses	22,700	18,300	41,000
Sub-Total	334,545	95,455	430,000
Contractor's Overhead and Profit			40,000
Engineering and Supervision			33,000
Total			503,000

B

	Material	Labor	Totals
Building Foundations	$ 7,975	$ 5,330	$13,305
Building Superstructure	53,735	40,040	93,775
Boilers and Firing Equipment	205,800	50,000	255,800
Controls and Instruments	12,700	2,400	15,100
Mechanical Draft Equipment	23,100	4,300	27,400
Dust Collectors, Breeching and Stack	30,300	7,470	37,770
Coal Handling System	45,810	13,810	59,620
Ash Handling System	23,550	400	23,950
Feedwater System (Zeolite)	32,400	5,100	37,500
Piping	64,660	30,520	95,180
Electrical Work	3,800	4,300	8,100
Direct Field Overhead Expenses	41,000	19,000	60,000
Sub-Total	544,830	182,670	727,500
Contractor's Overhead and Profit			50,000
Engineering and Supervision			47,500
Total			825,000

So—You're Going to Overhaul Your Turbine Generator!



A Power Engineering On the Job Feature

III. REMOVING TURBINE COVER AND SPINDLE

AXIAL CLEARANCES between rows of stationary and moving blades in a turbine are very small. When lifting the turbine cover or spindle, any slight tilting or sideways movement of cover or spindle could cause the blade rows to foul each other. Serious damage would then result, as blading is fragile compared to the great weight and momentum of the parts being lifted. So it is very important to make sure the cover and spindle remain exactly horizontal all the time they are being lifted, and this article describes how this is done.

Fig. 1. Removing sheet metal housing covering lagging and insulating blankets over h-p cylinder of turbine

This is the third article in a series describing the scheduled overhaul of a 25,000 kw turbine generator at U. S. Steel Corp.'s Chicago plant. First article, in April '55, was a preview of the whole series. The second, last month, described planning and preliminary work. Future articles will describe . . .

Turning turbine cover • Reblading • Metallizing eroded shaft • Work on generator • Lathe work on turbine • Checking clearances after reassembly • Realigning turbine spindle • Miscellaneous work • Safety and time-saving ideas

Removing Cover

WHEN all the joint bolts have been removed, four studs are installed, one at each corner of the machine, to maintain the cover in correct lateral and axial position until it is completely clear of the blading. Figs. 3 and 4 show these studs in position.

Then the cover is very slowly raised two or three inches and a gage check (Fig. 3) is made to see if the gap is the same all the way round the turbine. If it isn't, the level of the cover is adjusted by means of turnbuckles on the lifting slings (Fig. 2). This type of sling is always used for lifting cover and spindle, as it permits adjustments of level during the lift.

The cover is then lifted a little at a time, taking frequent scale measurements of the gap between the joint surfaces at each of the four corners to see that the cover remains level as it is raised and is not binding on any of the guides.

In addition to these precautions, men are stationed all round the machine while the cover is being lifted, as shown in Fig. 4, so that instant warning can be given if anything goes wrong.

Fig. 2. To prevent blade damage, cover must be absolutely level while it is being lifted. Here turnbuckles on lifting slings are being adjusted before lifting starts

Fig. 3. Checking gap during lift to make sure cover is level. Note one of four guide studs to maintain cover in correct axial and lateral position during lift

Fig. 4. Upper right. As turbine cover is lifted, gap is checked frequently to make sure cover remains exactly level during lift. Note men watching all around unit to give quick warning in case of trouble

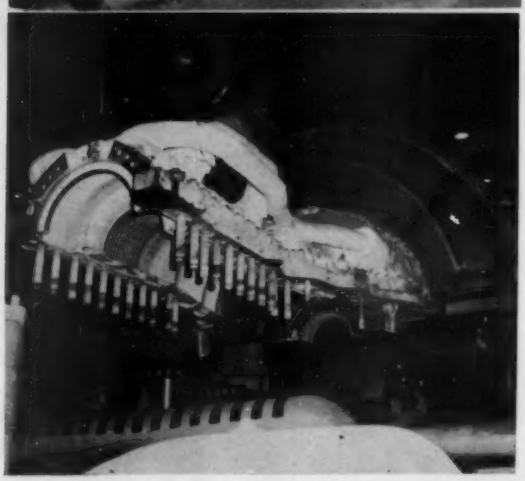


Fig. 5. Lower right. Cover clear of turbine. Note open end is down. For maintenance work it has to be set down with open end up. Method of turning it over will be shown in next article in this series

Lifting Spindle

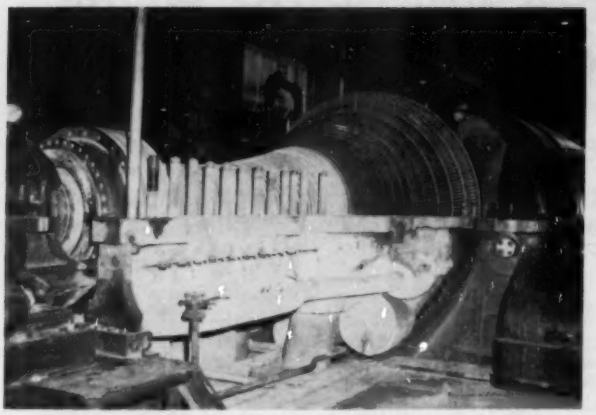


Fig. 6. View of spindle after cover has been removed from the turbine. Studs used to guide cover are being removed. Next job will be to lift spindle clear of turbine

TO PREVENT the spindle moving sideways or axially while being lifted, steel guides are bolted to the turbine cylinder. Two of these guides, which are well greased, are located so that the dummy piston slides between them as shown in Fig. 9. Similar guides are located at the 1-p end of the machine.

The height of the guides is such that by the time the dummy piston clears them, the spindle blading is clear of the turbine cylinder blading.

To make sure the spindle remains perfectly horizontal while it is being lifted, a spirit level is placed on the shaft at the h-p end, as shown in Fig. 7, the spindle is lifted about an inch, and the lifting rig turnbuckles are adjusted until the spirit level shows that the spindle is lying perfectly horizontal. Then the spindle is slowly raised, with the spirit level being watched to make sure it remains horizontal. Fig. 8 shows very clearly how the spirit level is used as a focal point during the lift as long as there is any danger of the blades fouling each other.

Once the spindle had been completely clear of the turbine body it was carried down to the maintenance bay and lowered on to a special skid as shown in Fig. 10.

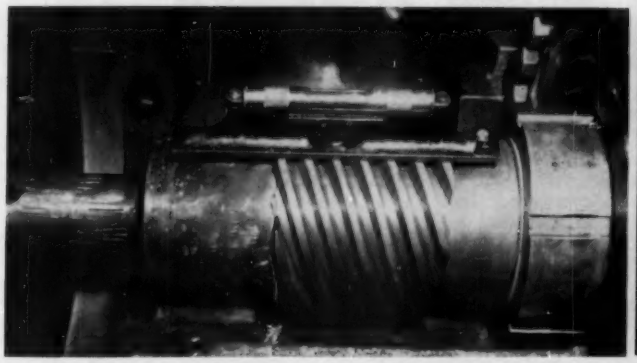


Fig. 7. To make sure spindle is level during lift, spirit level is laid on shaft as shown. Lifting rig turnbuckles are then adjusted until the spirit level shows spindle is exactly horizontal

Fig. 8. Spindle being raised. Note that John Janesic, Allis-Chalmers Erection Engineer in charge, while giving signals, watches the spirit level to make sure spindle does not tilt

Fig. 9. Shows dummy piston sliding between two steel guides bolted to cylinder horizontal joint at the h-p end. Similar guides are located at l-p end

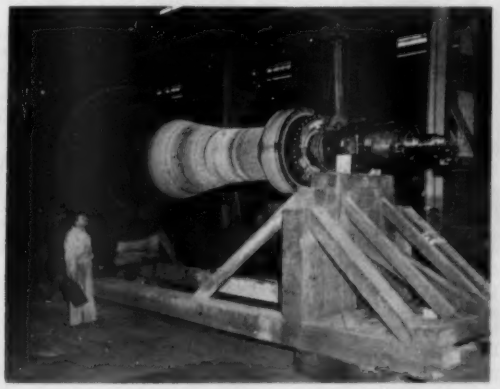


Fig. 10. Spindle being lowered on to special skid in maintenance bay. Blade deposits change color where steam changes from dry saturated to wet

Banton's Performance Calculator Helps You Cut Steam Costs

Power engineers, plant managers, purchasing agents, fuel men, are all concerned with cutting steam costs. This chart calculator enables you to figure and compare boiler efficiencies and steam fuel costs quickly, without laborious calculations, and saves you time and effort

By F. B. BANTON*

BANTON's Performance Calculator for steam generators burning coal, oil or gas fuels, shown on the opposite page, presents one application of a nomographic system of mathematics, consisting of parallel lines for addition and subtraction, and converging lines for multiplication and division. The chart is a condensed version of a large-scale chart. For use in practical calculations, you should obtain the chart corresponding to your pressure.

This chart has been plotted from the expression for the ratio of output over input and is designed to be uniformly accurate throughout. Four vertical lines and three horizontal lines drawn on the chart will accurately determine boiler efficiency. One more vertical and one more horizontal line will accurately give the fuel cost per thousand pounds of steam. No reference tables are necessary.

Periodic fuel analyses and operating data obtained from the conventional recording instrumentation found in modern plants are all that is necessary to use the calculator. Data from the following instruments are necessary:

1. Steam pressure recorder on boiler header;
2. Steam temperature recorder on boiler header;
3. Steam flow meter on boiler header;
4. Feedwater temperature recorder;
5. Quantity of fuel burned.

What Calculator Does

The calculator permits visual comparisons of different fuels and a permanent record of the boiler performances. Daily performances recorded on the calculator provide a visual yardstick for the boiler room personnel in obtaining the optimum in boiler operation. The calculator is an excellent tool for purchasing agents and fuel salesmen. It bridges the technical calculation without tears for the layman, and saves time and effort for the engineer. It is unnecessary to convert the performance data to the equivalent evaporation "from and at 212 F," or to determine the evaporation factor, for the resultant efficiency read on the chart is the actual ratio of output over input for comparison.

Knowledge of boiler efficiency is vitally necessary to the engineer, but of no less importance is the knowledge of fuel cost of the steam evaporated. Boiler efficiency is a factor in the determination of the fuel cost of steam produced. Boiler efficiency states the percentage of the Btu purchased in the fuel that is available in the steam produced for doing useful work.

Effect of Fuel

A fuel could very well produce steam at an excellent efficiency, but be so priced that it would not be competitive with a lower grade fuel at a lower efficiency. It is also important to remember that all boilers do not, and are not designed to, perform alike. Therefore, it does not hold that a specific fuel, giving good performance in one boiler under certain conditions, will produce equally well in another boiler, or under other conditions.

Example: Illustrating the use of the calculator, data are as follows:

Hypothetical Conditions

Steam—700 psig, 900 FTT;
h_s = 1458 Btu per lb
Feedwater temperature—300 F;
h_s = 270 Btu per lb
Net Btu added by boiler—
h_{fg} = 1188 Btu per lb

Those Btu values above are shown on the left side of the calculator.

Coal — 9000 Btu per lb with 6 lb steam evaporation rate
Oil — 150,000 Btu per gal with 95 lb steam evaporation rate
Gas — 100,000 Btu per therm with 60 lb steam evaporation rate

Solution of Problem: Follow instructions on calculator. Assume coal cost laid down in the bunker is $5.50 per ton. Divide the boiler efficiency per cent line by 10, as stated in the instructions, and enter the chart at the bottom. Move vertically upward on the 55 line (this is the $5.50 per ton of coal line also) to the intersection of the 6 lb evaporation rate line, then move to the right and read the fuel cost of 46 cents per thousand pounds of steam.

Using the fuel cost of coal at 46 cents per thousand pounds of steam as a basis for comparison, divide the 46 cents by 2, as stated in the instructions, and draw a horizontal line across the chart through the 23 cent line. Extending the evaporation rate lines of oil and gas to the intersection of the 23 cent line, read the cost per gallon of oil and the cost per therm of gas necessary to be equivalent to the fuel cost of steam produced from coal at $5.50 per ton.

For unit costs of fuel greater than 10, divide the fuel cost by a convenient factor of 2, 3, 4 or 5 and enter this divided value at the bottom of the chart and return vertically to the corresponding evaporation rate. Move horizontally to the right and read the coal cost, which then must be multiplied by the original divisor.

* Engineer, Downers Grove, Ill. All republication rights reserved by author.

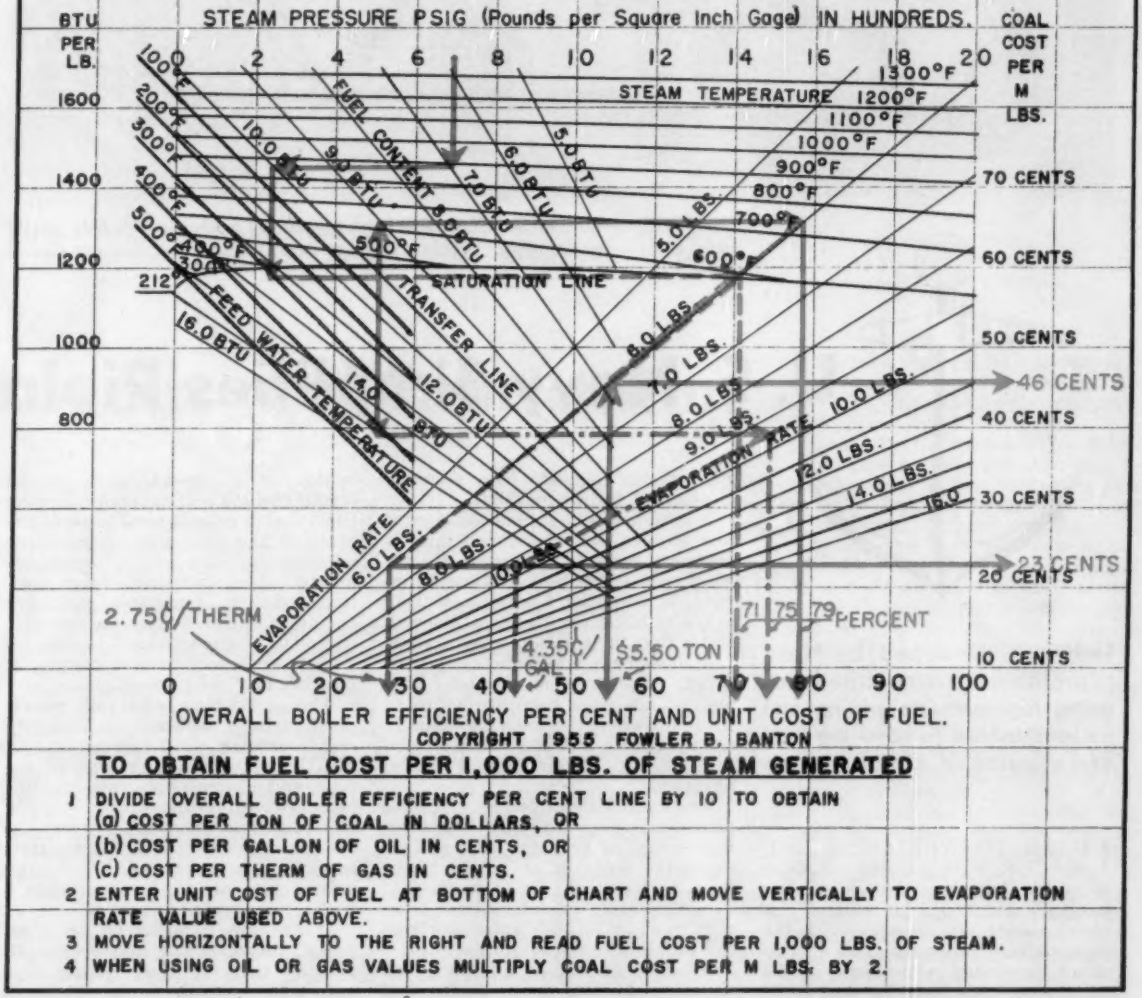
WANT A LARGE-SCALE CHART?

Reproductions on a larger scale for greater accuracy in reading the chart will be available. Write the Editor or jot BANTON'S CHART and your nominal boiler pressure on the prepaid post card you will find elsewhere in this issue and drop it in the mail.

INSTRUCTIONS FOR USING CALCULATOR

1. ENTER CHART AT TOP WITH STEAM PRESSURE AND DROP VERTICALLY TO STEAM TEMPERATURE.
2. MOVE HORIZONTALLY TO TRANSFER LINE 10.0 BTU.
3. DROP VERTICALLY TO BOILER FEED WATER TEMPERATURE IN DEGREES FAHRENHEIT.
4. MOVE HORIZONTALLY TO TRANSFER LINE 10.0 BTU.
5. MOVE VERTICALLY TO BTU CONTENT IN FUEL. USE "AS RECEIVED" VALUE.
6. MOVE HORIZONTALLY TO EVAPORATION RATE.
7. DROP VERTICALLY TO READ OVERALL BOILER EFFICIENCY IN PER CENT.

NOTE- IN STEP 5 MULTIPLY CHART VALUES BY 1,000 FOR BTU PER LB. OF COAL, AND BY 10,000 FOR BTU PER GALLON OF OIL. USE TRANSFER LINE 10.0 BTU FOR 100,000 BTU PER THERM OF GAS. IN STEP 6 MULTIPLY CHART VALUES BY 1 FOR LBS. OF STEAM EVAPORATED PER LB. OF COAL BURNED, AND BY 10 FOR LBS. OF STEAM EVAPORATED PER GALLON OF OIL, OR THERM OF GAS.



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TO OBTAIN FUEL COST PER 1,000 LBS. OF STEAM GENERATED

1. DIVIDE OVERALL BOILER EFFICIENCY PER CENT LINE BY 10 TO OBTAIN
   (a) COST PER TON OF COAL IN DOLLARS, OR
   (b) COST PER GALLON OF OIL IN CENTS, OR
   (c) COST PER THERM OF GAS IN CENTS.
2. ENTER UNIT COST OF FUEL AT BOTTOM OF CHART AND MOVE VERTICALLY TO EVAPORATION RATE VALUE USED ABOVE.
3. MOVE HORIZONTALLY TO THE RIGHT AND READ FUEL COST PER 1,000 LBS. OF STEAM.
4. WHEN USING OIL OR GAS VALUES MULTIPLY COAL COST PER M LBS. BY 2.

Banton's Performance Calculator for Steam Generators Burning Coal, Oil or Gas

Conditions: Steam 700 psig, 900 FTT; feedwater 300 F. Fuels: Coal, 9000 Btu per lb; oil, 150,000 Btu per gal; gas, 100,000 Btu per therm. Evaporation rates: Coal, 6 lb steam per lb coal; oil, 95 lb steam per gal; gas, 60 lb steam per therm.

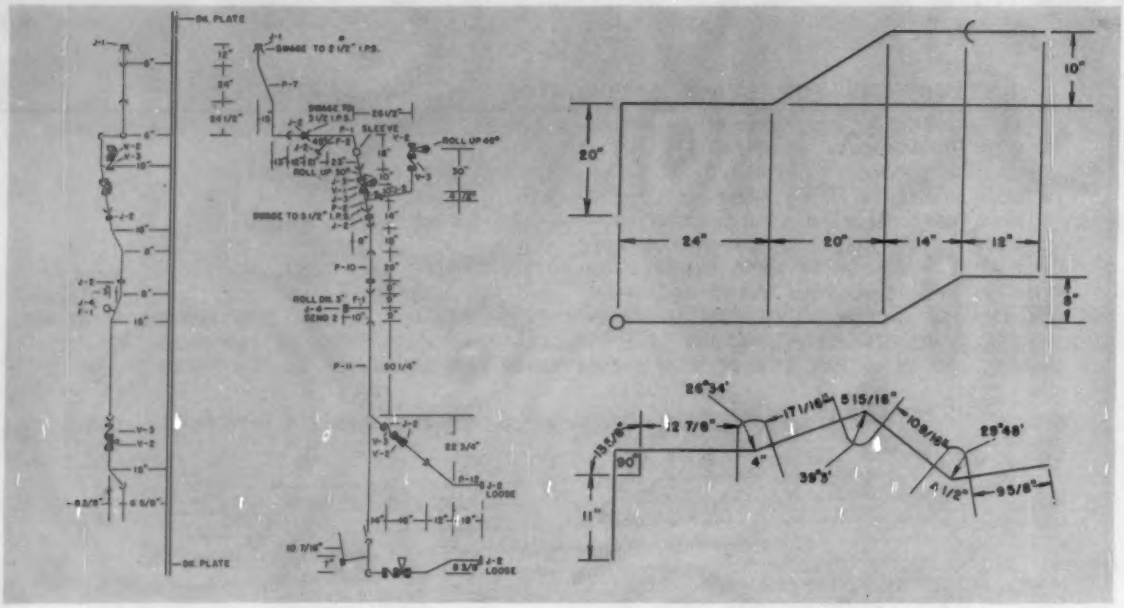


Fig. 1. Left — redrawn sketch of pipe layout made by mechanic with only simple tools. Right — typical layout problem given to shop. (Perspective view not shown)

U. S. Navy Simplifies Piping

Technique developed by Navy to prefabricate complicated seagoing high-pressure piping can be used ashore to save the time and expense of slower methods

PRIOR TO WORLD WAR II, the U. S. Navy's Bureau of Ships specified that the Van Stone, or lapped joint, would be required for high-pressure piping exposed to the higher steam pressures. This specification presented a problem to the naval pipe shops. Since bending could not be done until after the forming and machining of the Van Stone lap, all such pipe sections had to be cut initially to exact lengths that would account for both the stretch due to bending and the amount necessary to roll up the laps.

Laying out a projected pipe run that would incorporate lap joints involved the costly practices of template making, use of template materials, or the slower, less accurate mechanical layout method.

A practical and simple solution to this problem was developed, and is described by J. B. Chandler, Master Mechanic, Puget Sound Naval Shipyard, Washington. Chandler, writing in the publication, *BuShips Journal*, states that the solution was obtained "by devising a mathematical layout which considered all factors. This method has since been developed to the point where it is used on virtually all piping laid out and prefabricated in Shop 56, Puget Sound Naval Shipyard."

The method described by Chandler provides many desirable features: high degree of accuracy, fast and inexpensive solution of layout problems, a clear and concise method of communicating job information from ship to shop, and an automatic record of job information on paper.

Another important advantage of the method is that the predetermined length of each pipe section, plus the accurate evaluation of the limitations peculiar to either hot or cold bending, has made the problem of scrap pipe practically non-existent.

The method described by Chandler for pipe layout and prefabrication is divided into three operations: shipboard or on-the-job sketching, shop layout, and shop prefabrication.

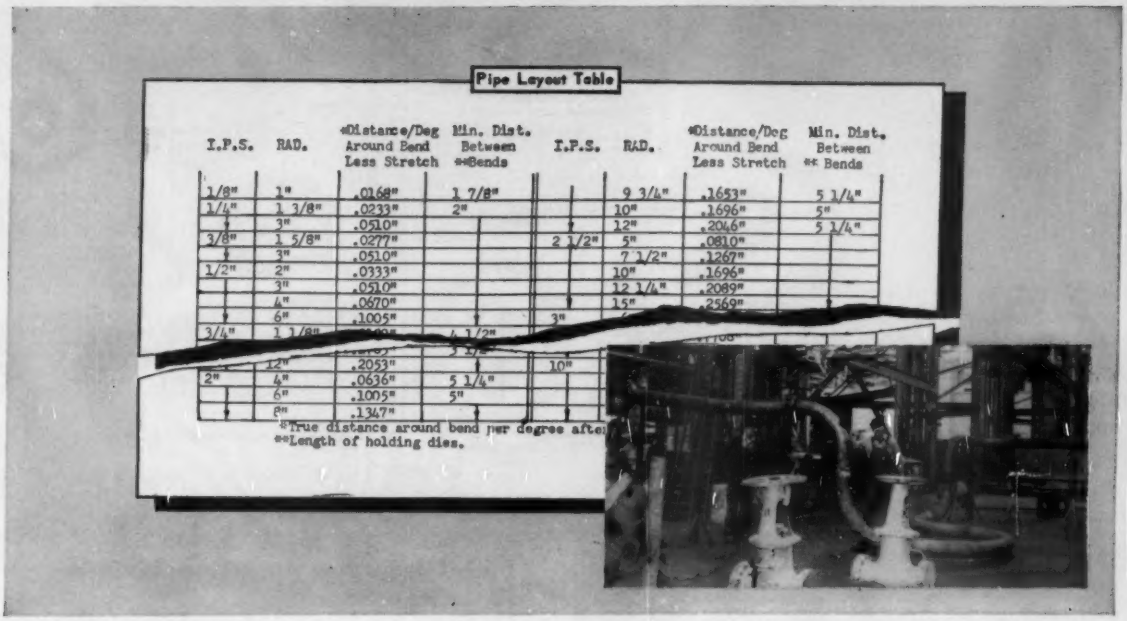
On-the-Job Sketching. In the shipboard, or on-the-job part of the layout method a line sketch following basic design rules is used to show the route of the pipe and all pertinent information, such as "X" measurements, offset distances, valve positions, fitting numbers, etc. For example, a sketch may consist of a complete compartment layout, a deck-to-deck section of a system, or possibly just one piece of pipe.

The layout man needs only simple portable tools to obtain the necessary measurements for fabrication. A chalkline centerlines the run of the pipe, and a plumb bob, rule, and line level are used for measuring.

All holes are marked for cutting as the measurements are taken. Butt marks, frame marks, and other shipwright data are used to maintain a higher degree of accuracy.

If the job happens to be a renewal, the sketching may be simplified by drawing the existing pipe before it is removed. At the same time any previous errors that exist, such as unnecessary fittings, close radius bends, unnecessary or cocked flanges, etc., can be eliminated.

Figure 1 is a redrawn sketch of a difficult pipe layout. The original, unsuitable for reproduction, was made by a mechanic with simple portable tools in much less time than it would take to develop a set of templates.



Pipe Layout Table

I.P.S.	RAD.	*Distance/Deg Around Bend Less Stretch	Min. Dist. Between **Bends
1/8"	1"	.0168"	1 7/8"
1/4"	1 3/8"	.0233"	2"
	3"	.0510"	
3/8"	1 5/8"	.0277"	
	3"	.0510"	
1/2"	2"	.0333"	
	3"	.0510"	
	4"	.0670"	
	6"	.1005"	
3/4"	1 1/8"	[illegible]	4 1/2"
	12"	.2053"	
2"	4"	.0636"	5 1/4"
	6"	.1005"	5"
	8"	.1347"	

I.P.S.	RAD.	*Distance/Deg Around Bend Less Stretch	Min. Dist. Between ** Bends
	9 3/4"	.1653"	5 1/4"
	10"	.1696"	5"
	12"	.2046"	5 1/4"
2 1/2"	5"	.0810"	
	7 1/2"	.1267"	
	10"	.1696"	
	12 1/4"	.2089"	
	15"	.2569"	
3"	[illegible]	[illegible]	
	10"	[illegible]	

*True distance around bend per degree after
**Length of holding dies.

Fig. 2. Sample of pipe layout table as it is drawn up by Puget Sound Navy Yard for prefabricating high-pressure piping. Inset shows an example of this pipe work

Layout and Fabrication

Shop Layout. When the shipboard or job scene sketches have been completed, with the job order and the identification information attached, they are sent to the shop layout department to be developed for shop manufacture and prefabrication.

The nucleus of the shop layout system is the mathematical computation of all bending angles, distances around bends, pipe stretch, over-all lengths, and other similar facts necessary for fast, easy, and accurate shop work. The mathematics used in this method has been simplified to such an extent that all layout problems may be computed by simple trigonometry. Tables are compiled and calculating machines utilized so that the method may be easily learned by the average mechanic with a minimum of specialized training.

After the shipboard sketch is received by the shop layout man, he carefully analyzes the layout problem involved in each section of pipe. If the pipe is to be bent, a standard radius should be designated. The length of the holding dies, the turning radii, and the other limitations of the bending machine are considered and the following computations made: (1) The angles of the bend is calculated to the nearest minute; (2) the length of the arc with allowance for pipe stretch is calculated; and (3) the total length of each pipe section is computed. See sample of Pipe Layout Table in Fig. 2 for stretch calculations.

If bends that lie in more than one plane are involved, the position of each bend with respect to the plane of the preceding bend is calculated. The roll angle of the pipe, necessary in order that the mechanic may make each bend on a horizontal plane, is obtained from these calculations.

In simplifying the layout and manufacture of rolled bends, more rolls are generally used. This practice eliminates bends and lessens flow restriction. As shown in Fig. 1, a double offset is accomplished with three bends instead of four.

All of the layout calculations are assembled on a card. A small perspective made of rigid wire is added to give the mechanic a visual picture of the bends in their respective planes. The layout card is then ready for the mechanic and for the fabrication of the pipe section.

The mechanic may then cut his pipe to an exact length, mark off the measurements as shown, and, by following the detailed bending instructions, complete a fast and accurate fabrication of the pipe section. An angle protractor is used to measure the angle of bend and a level protractor is used to measure the angle of roll.

Figure 1 shows a typical shop layout problem and the completed layout as it is given to the mechanic. The perspective is not shown.

Shop Prefabrication. The fabricated pipe sections are then sent to the shop pre-fab floor and set up in a true position in accordance with the ship sketch data and the additional data supplied by the shop layout men. Here, the branches, valves, and flanges are installed in their proper positions and all permanent brazing and welding is done. The pipe is checked for accuracy of manufacture. Then the sections are tagged in sequence, tested, and shipped to the vessel for installation.

The inset of Fig. 2 shows a typical prefabrication setup on steam catapult piping nearing completion by Shop 56 mechanics.

Analysis of the method used will demonstrate that, from the time the job is started on shipboard to the time that the material fabrication is begun in the shop, no material, templates, mock-ups, or special tools are used. Labor used is confined to that necessary for rip-out, sketching, and shop layout. Except for rip-out, all work is confined to plans, sketches, and layouts where corrections and alterations may more easily be made with no waste of material.

An example of the method described in this article is illustrated by the piping on a recent catapult conversion on a carrier. All of the major piping was sketched on the ship and location and then prefabricated entirely in the shop. Upon installation, not one piece required altering.

Chalmette Steam-Electric Plant

Third in a series describing the power facilities at Kaiser Aluminum & Chemical Corporation's aluminum reduction plant, this installment deals with the steam turbine generators at Chalmette

By E. F. BOOBYER

Power Manager, Chalmette Works, Kaiser Aluminum & Chemical Corp.

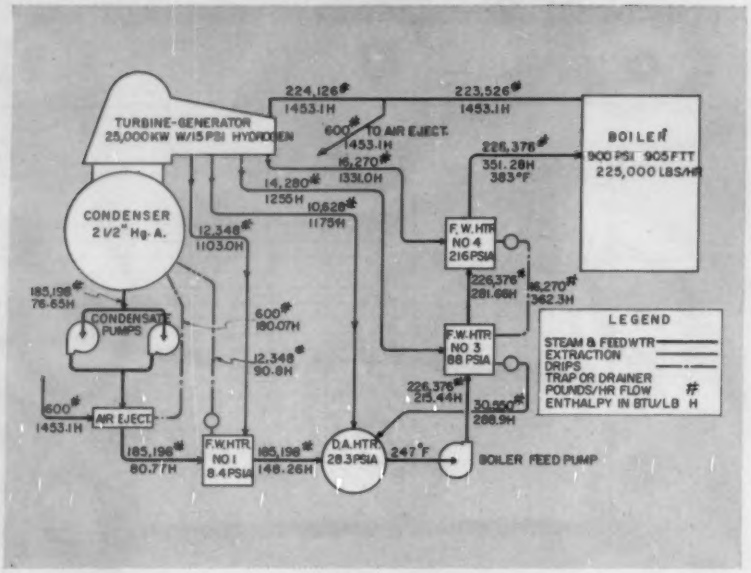


Fig. 1. Diagram shows heat balance of 20,000-kw units

Fig. 2. Heart of plant's power facilities, turbine room shows impressive line-up of 20,000-kw units. Note individual panels

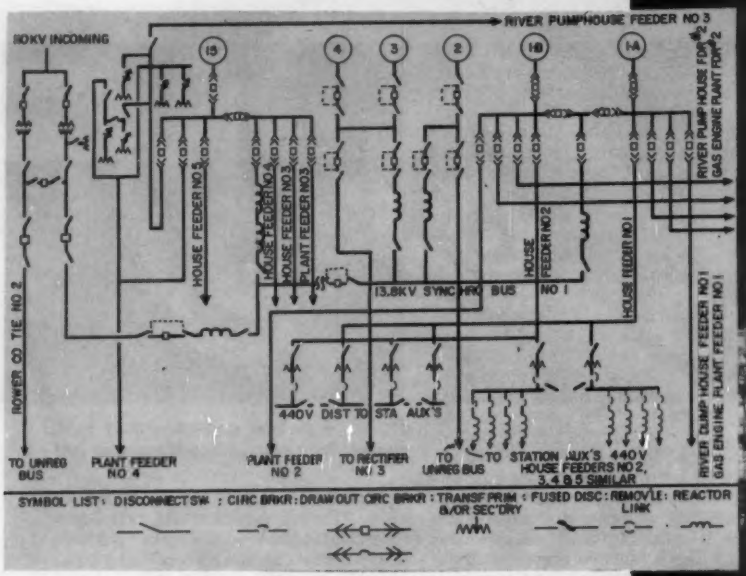

RIVER PUMPHOUSE FEEDER NO 3
110KV INCOMING
15
4
3
2
1B
1A
RIVER PUMPHOUSE FDR NO 2 GAS ENGINE PLANT FDR NO 2
HOUSE FEEDER NO 3
HOUSE FEEDER NO 3
PLANT FEEDER NO 3
13.8KV SYNCHRO BUS NO 1
HOUSE FEEDER NO 2
HOUSE FEEDER NO 1
RIVER PUMPHOUSE FEEDER NO 1
GAS ENGINE PLANT FEEDER NO 1
POWER CO TIE NO 2
440V DIST TO STA AUX'S
TO UNREG BUS
PLANT FEEDER NO 4
PLANT FEEDER NO 2
TO RECTIFIER NO 3
TO UNREG BUS
TO STATION AUX'S 440V HOUSE FEEDERS NO 2, 3, 4 & 5 SIMILAR
SYMBOL LIST: DISCONNECT SW. : CIRC BRKR: DRAW OUT CIRC BRKR : TRANSF PRIM & /OR SEC'DRY : FUSED DISC : REMOVLE LINK : REACTOR

Fig. 3. Single-line diagram of 13.8-kv distribution system

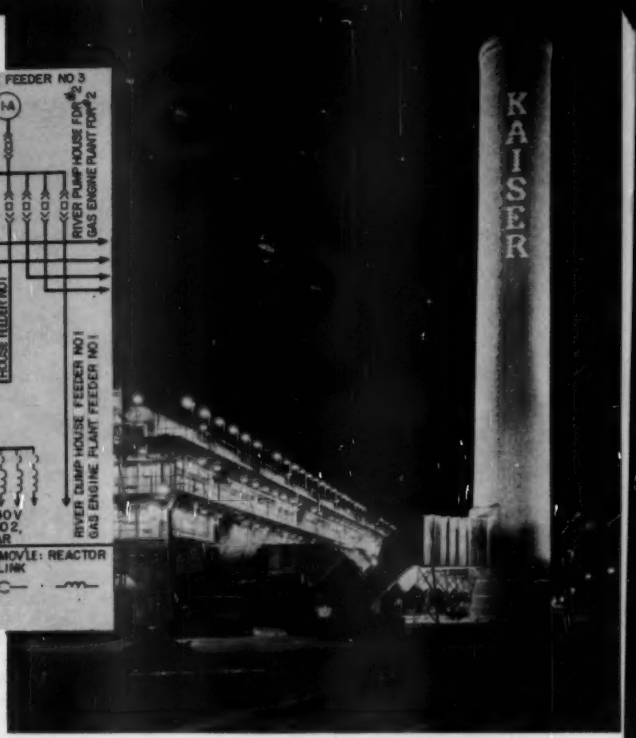


Fig. 4. Dramatic night view of boilers and stack. Cooling towers at right; induced and forced draft fans in center

Flexes Its Muscles

ESSENTIALLY, the heart of the power facilities at Chalmette is the Steam-Electric Plant. The plant is basically a series of fifteen identical "unit" systems, tied together so that a restricted steam and power flow between units is possible.

Each unit consists of a Foster Wheeler "D" type, express, gas-fueled boiler, rated at 225,000 lb per hr at 1000 psig and 905 F, delivering steam to a preferred standard General Electric 20,000-kw turbine-generator set with a hydrogen-cooled generator. Turbine-generators are capable of 25,000 kw continuously. Turbines are condensing, rated at 2½-in. Hg back pressure with 850 psig and 900 F throttle conditions; they are equipped with four extraction lines feeding one low pressure, one deaerating, and two high pressure feed water heaters. A single boiler feed pump serves the combination. Heat balance diagrams are shown in Figs. 1 and 6.

The individual boiler steam lines are continually cross-connected to form a small diameter sectionalized main steam header, through which an interchange of about 125,000 lb per hr can be accommodated in any direction, in each of the cross-connecting lines between two neighboring main steam leads. This allows any excess steam capacity in one system to be utilized in another, and also permits certain boilers to be base loaded while swinging with load demand on those remaining.

Power at 13.8 kv from individual generators flows through the unit air circuit breaker to a bus also serving as a termination for the neighboring generator leads. This short unit bus is connected through an air breaker and disconnect to an overhead exterior feeder, to a 13.8-kv regulating transformer, and then to the bank of rectifier frames supplying d-c power to a potline. In addition, the short unit bus is connected through a breaker, disconnect, and reactor to a continuous 13.8-kv metal-clad aluminum synchronizing bus that runs the full length of the turbine deck. Thus, each pair of 12 generators feeds directly to a potline feeder and also, through a restricting reactor, to a common bus so that power interchange up to 25,000 kw is possible. Power can flow across the reactors in either direction and allows extensive manipulation of flows during outages or curtailments at individual turbine-generators stemming from either turbo-generator, boiler, or major auxiliary trouble. (See Fig. 3.)

A single turbine-generator (No. 2 unit) is connected directly to the synchronizing bus through a breaker, disconnect, and reactor and also through a breaker, disconnect, and overhead 13.8-kv feeder to the "unregulated bus" of the Rectifier Station.[1] This arrangement allows delivery up to 50,000 kw to the "unregulated bus" and also permits this single turbine-generator to feed up to 25,000 kw into the synchronizing bus for use anywhere in the power systems connected to that bus.

The turbine deck is entirely enclosed and supported above an auxiliary deck that is partly enclosed (See Fig. 5). The turbine room structure is of brick, concrete, steel framing, and aluminum siding. Boiler installation (Fig. 8) is of the outdoor type, the only enclosed area being the firing aisle.

The 15 express type boilers are identical and are capable of continuous performance at 250,000 lb per hr at rated conditions. Operating conditions in the Reduction Plant dictate an almost constant power demand at about rated capacity of the power facilities; thus, total steam load fluctuates through about 100,000 lb per hr only, under normal conditions. However, when trouble in the Reduction Plant or Rectifier Station occurs, the steam load demand can fluctuate instantaneously in blocks of 475,000 lb per hr. Instantaneous decreases in steam demand up to 1,425,000 lb per hr have been experienced, and instantaneous increases in demand of two successive blocks of 475,000 lb per hr in 5 minutes have been known.

No automatic or mechanized superheat control is supplied; the single superheater element is of the convection type located behind the bank of screen tubes and maintains a nominal rated superheat temperature at rated load. Trimming of the fuel combustion to hold rated superheat is accomplished by manipulation of the Peabody burner air registers and air diffusers; such manipulation allows about 25 F of superheat control and is sufficient to promote standard superheat conditions at the turbines.

Natural gas of about 1110 Btu per cu ft quality is the only fuel burned, although the boilers are designed for fuel oil also. Six Peabody burners

receive the gas fuel at pressures from 1 to 10 psig and perform the combustion of the fuel with about 5 per cent excess air at rated boiler load. Automatic conbustion control increases excess air at lower steaming loads, as a measure toward maintaining superheat temperature at the lower steaming rates.

Gas temperatures leaving the boiler setting are 670 F at rated load. Flue gas is further used through a rotary Ljungstrom air preheater to raise incoming combustion air temperatures to 550 F and reduce stack flue gas temperatures to about 260 F.

Heat release at 225,000 lb per hr, steam flow is 35,000 Btu per cu ft per hr, and the two-drum watertube boiler contains only 77,000 lb of water when filled to normal level under cold conditions. A swell of drum level of about 5 in. is experienced when steaming loads are increased from 100,000 lb to 225,000 lb per hr. To compensate for this "swelling," the automatic drum level control is designed to maintain a level 4 in. above normal at full steaming load, and 3 in. below normal at 50,000 lb per hr.

Combustion air is supplied from a single forced-draft fan and the exhaust gases are withdrawn from the boiler setting by a single induced-draft fan discharging to a brick stack. Air flow control, as part of the combustion control, is governed by the vane inlet controls of the induced-draft fan and the synchronized inlet vane controls of the forced-draft fan.

Bailey pneumatic controls provide fully automatic control for each boiler, and include three-element combustion control, three-element boiler drum water level control, purge interlock, furnace draft control and draft fan, and air pre-heater interlock. All functions can be controlled alternately by hand. An automatic-manual boiler master controller allows each individual boiler to be base loaded with the local functions automatically controlled, or to be mastered by one of two "station master" controllers, both of which function to maintain constant main steam header pressure. Each of the station master controllers can control all 15 boilers or a selected lesser number of boilers.

The 13 turbine-generators supplying power to the potlines are identical and capable of delivering 25,000 kw with a 2½-in. Hg backpressure and with 15 psig hydrogen pressure at the generator. The turbine is of standard General Electric impulse-reaction design of 3600 rpm and exhausts into solidly-footed twin-wing Worthington two-pass, 9300-sq-ft condensers. The exhaust flange of the turbine casing makes up solidly to the upper flange of an inverted "T" piece; expansion joints are supplied at the two other flanges where it makes up to the two wing condensers.

Automatic turbine-trip functions respond to low condenser vacuum and the generator lead differential relay. Emergency manual trip function is also provided. Various audible and visual annunciators announce trouble functions at the individual turbine control panels and the individual hydrogen control panels. At these panels are also located the control switches for the various turbine and hydrogen system auxiliaries that are located on the auxiliary deck. (See Fig. 7.)

Each condenser is equipped with two multi-stage vertical Worthington condensate pumps, one of which is normally operating and the other automatically controlled for stand-

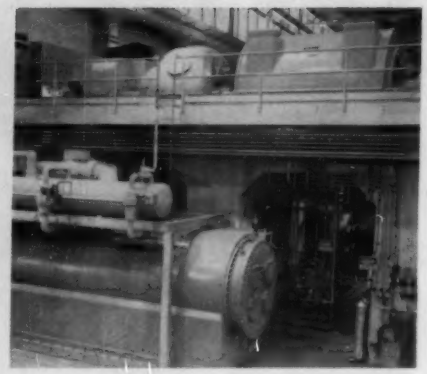


Fig. 5. A turbine and condenser half; feedwater heater on condenser at left

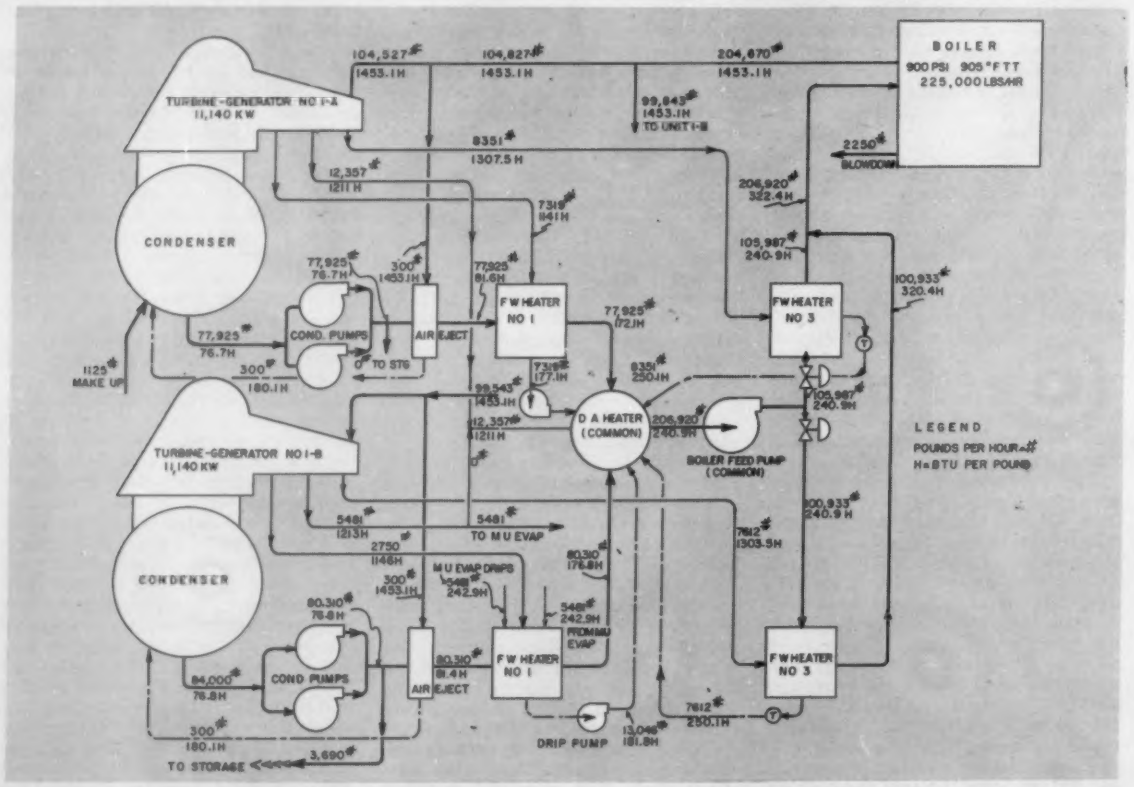


Fig. 6. Combined heat balance of 10,000-kw turbine-generators Nos. 1A and 1B; the deaerating heater is common to both units

Fig. 7. Steam Plant Step II control board. Board has annunciators and controls for turbine-generator sets Nos. 7 through 15. The Step I board controls other units

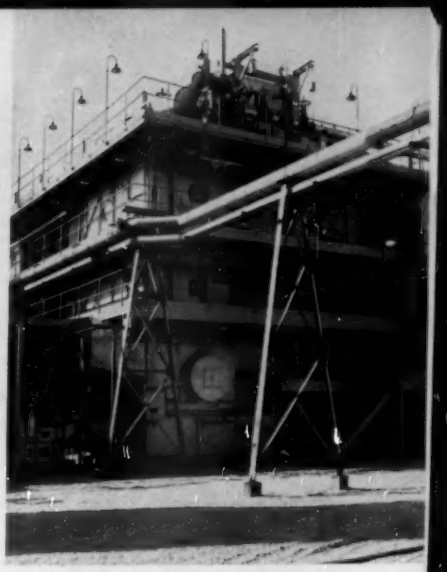


Fig. 8. North side of boiler No. 6; at left is the regenerative type air heater

by start. The condensate rejection-makeup system is controlled automatically from condenser hotwell level, and a system of surge tanks, common to all condensers, provides the space for rejected water and also supplies makeup water. Makeup water totals at an average 0.50 per cent of total boiler steam flow.

Following the condensate pumps, each unit feedwater-condensate system is comprised of an air ejector condenser, a low-pressure tubular type feed water heater, an elevated spray-type deaerating heater, a multi-stage Worthington boiler feed pump at the deaerator outlet, and two Griscom-Russell high-pressure tubular type feed water heaters. The feed water heaters are supplied with extraction steam and the final feed water temperature to the boiler at rated load is about 380 F.

Makeup evaporators are of the double-effect type, supplied with steam from the associated turbine extraction system and discharging the makeup vapor to a low-pressure feed water heater. Feed water from a sodium-hydrogen zeolite treatment plant is supplied to the evaporators at near zero hardness. This treatment plant has a capacity of 70 gpm when supplied with domestic water at 8.0 pH, and up to 400 ppm total hardness; it is semi-automatic and equipped with a deaerating heater following the zeolite treatment.

Raw water for condenser cooling is supplied from a pumphouse located in the Mississippi River and delivered above ground through 1950-ft-long steel lines. The river water temperature varies from 46 F to 86 F during the year, with a possible high temperature of 91 F. The turbidity varies from 20 ppm to 600 ppm. The gentle scouring action of the high-turbidity water during about four months of the year maintains a high degree of external condenser cleanliness. No algae growths have been discovered as yet within the condenser water system and the comparatively fresh river water does not appear to support growth of marine life within the system.

The pumphouse is equipped with five 35,000 gpm and three 60,000 gpm Worthington, vertical, open impeller, dry-suction type pumps, driven by synchronous motors at 2300 volts. Three 13.8 kv overhead feeders from the Steam Plant terminate in 13.8–2.3 kv transformers to supply power to the pumphouse. Each feeder is capable of carrying the full electrical load of the pumphouse necessary to supply adequate condenser water under average operating conditions.

Standby-start features are provided to start automatically selected pumps in event of a partial loss of water pressure to the condensers; various annunciators warn of trouble in the pumphouse. Such warnings are relayed to the neighboring Domestic Water Plant.

An intake grizzly structure is located about 150 ft farther into the river than the pumphouse and incoming water flows through the wide-mesh screen grizzly, through submarine piping to the automatically-washed fine screens in the pumphouse and thence to the circulating water pumps.

All the various "house" loads are fed from two separate house busses located in the Steam Plant that are connected to the synchronizing bus through breakers, disconnects, and reactors. Feeding one of these metal-clad house busses are two 12,500-kw air-cooled generators while a single 25,000-kw hydrogen-cooled generator feeds the other. The total house peak demand is on the order of 38,000 kw, and power can flow to and from the house busses and the synchronizing bus through the limiting reactors.

The preferred loads fed from the house busses are through withdrawable-type switchgear and serve the steam power plant, the gas engine plant,[2] the river pumphouse, and the domestic water plant; four feeders provide power for the auxiliary functions in the Reduction Plant.

The five 13.8 kv feeders serving the steam power plant from the house busses are carried in conduit within the plant and serve 15 500-kw, 13,800/480-v transformers. Each pair of transformers, where the individual transformers are fed from different feeders, serves a main load center. The main load centers comprise two sections that may be tied together by a tie breaker and both sections can be served adequately by one of the associated transformers. Each section of the main 480-v load center supplies house power to a single complete unit system including the turbine-generator auxiliaries, boiler auxiliaries, and some other common auxiliary such as lighting, instrument air compressor, or cooling tower, etc. Local 480-v load centers are provided at each turbine-generator and boiler for redistribution of the power locally. These are normally fed from the associated section of a main 480-v load center. Some critical functions have a standby power source from the companion section of the same main 480-v load center also; condensate pump, lighting transformers, heater drip pumps, and seal water pumps are fed in this manner.

Typical operating statistics of the steam power plant are given below:

Station capacity	375,000 kw
Average net heat rate	12,925 Btu/kwh
Average gross heat rate	12,300 Btu/kwh
Average house load	5.10 per cent
Average monthly load factor	90.5 per cent
Average boiler efficiency	83.0 per cent
Feedwater makeup (of total steam flow)	0.50 per cent

Throughout the construction of the plant close liaison was maintained between the construction and operating groups. A coördinator who was a member of the operating group was responsible for the interests of the operators and reported directly to the Power Division Manager. In the field he worked closely with his superior.

This system resulted in an almost trouble-free start-up when the turbine plant went on the line.

[1] The Rectifier Station was described in the May, 1955 issue of POWER ENGINEERING.

[2] An article on Chalmette's Gas Engine Plant appeared in the March, 1955 issue of POWER ENGINEERING.

Operate Your Underfeed Stokers Properly

Operators have many opportunities to analyze stoker performance and prevent trouble before serious damage is done. But to do this they need to know their equipment thoroughly. Here's a review of operating fundamentals, with some ideas that may be new to you

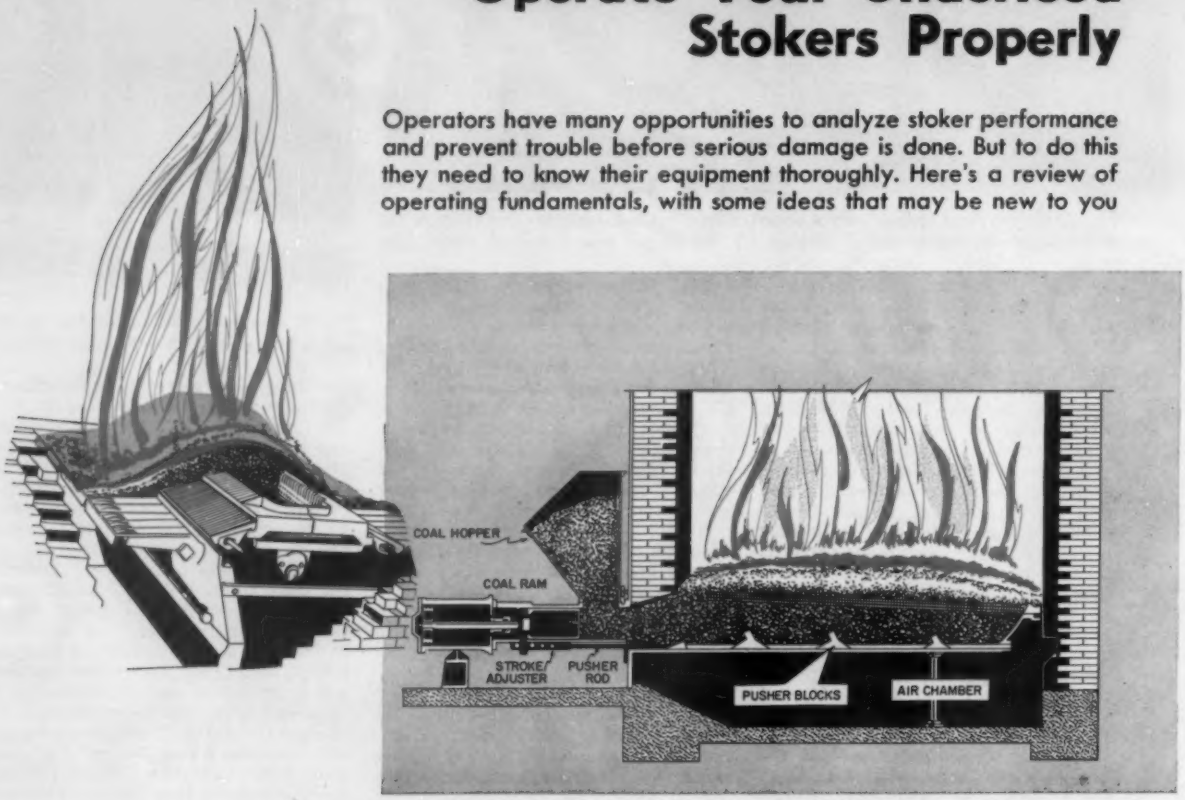


Fig. 1. Two views of ram-operated side dump stoker. Coal bed thickness controlled by pusher rod and blocks. Coal travels sideways by gravity over sloping grates

By **DONALD M. GIVEN** *

IN MANY BOILER HOUSES you will hear a lot of grumbling; one day the coal has too many fines . . . another day it has too many lumps . . . another day it's too dry . . . another time it's too wet. The men who grumble often forget that the stokers and combustion controls have certain adjustments for the specific purpose of accommodating these variations in coal quality, and the operator's job is to make the adjustments rather than complain about the coal.

An operator, whether in a big modern plant with the latest equipment, or a small plant with old equipment, is in an excellent position to analyze troubles and take corrective action before any serious damage can be done. But first he must be trained so that he knows how his equipment works and can interpret unusual behavior. A point worth mentioning here concerns drawings and instruction manuals, which should be more easily available for operators to read and which should be read more frequently by operators. It is all very well to say a stoker will not feed wet coal, but I strongly advise checking the instruction manual to see what the designer has to say about adjusting for wet coal. The same thing applies to all other faults in operation that are so frequently blamed on the quality of the coal.

Basic Principles

I am quite convinced that training operators and giving them some incentive and opportunity to help themselves to further training is of major importance. In presenting this review of the basic fundamentals of stoker firing I hope that the repetition will help those who have forgotten many of the principles they knew years ago, and may perhaps give others a few ideas that might not have occurred to them before.

We can probably concentrate on the ram type of underfeed, either side dump, single retort or multiple retort, as used for capacities in excess of 8000 or 10,000 lb steam per hr. The coal is pushed into the retort by the main ram and distributed along the stoker length by the pusher blocks. It is here in the retort that the green coal is gradually heated and coked — the volatile gases moving up through the bed to be ignited and burned as a flame above the bed. The coke that remains is pushed up into the burning zone by the coal coming in behind it. From here on, the coke burns gradually to ash as it moves slowly toward the dump grates.

In the retort, the temperature of the coal gradually increases and at 212 F, the moisture is evaporated. Then at about 700 F to 800 F the coal begins to soften and swell up, and to release some of its volatile matter.

* Fuel Engineer, Fairmont Coal Bureau.

Obviously, it is important not to let the fuel bed burn too thin and start active combustion while the coal is still quite soft and sticky. It would all stick together and form large coke trees that would interfere with the fuel-bed distribution. Once the coke reaches the top of the fuel bed and is ignited, all that remains is to move it toward the ash pit at a rate which will allow it to burn almost completely to ash by the time it reaches the dump grates.

The designers have provided for these events to take place in a natural progression and without trouble so long as the operator keeps the stoker adjusted for uniform distribution and the combustion controls adjusted for the proper fuel-bed thickness. The operator should visualize the bed as a reservoir of fuel available to be burned in proportion to the air being supplied. The combustion controls are designed to automatically vary the coal feed with the load demand and to admit just enough air to burn up the same amount of coal as is being fed into the bed. If too much air is supplied, the bed becomes thinner and too little air causes the bed to thicken.

The operator must initially provide the proper thickness and then let the controls take over. He must also keep the stoker adjusted to feed all parts of the bed uniformly if the combustion air and the burning are to be uniform over the fuel bed. When a thin spot develops, the air rushes to go through the bed at that point, taking the path of least resistance and being diverted away from the thicker parts of the bed. Thus, while the load conditions may call for burning 25 lb of coal per sq ft per hr, the thin spot might be burning at several times that rate to compensate for the rest of the bed being less active. Naturally, a hot spot develops, causes a clinker, and increases the grate temperature where the hole in the bed has occurred. The operator will recognize that a hole is developing either by observation of the fuel bed or by a drop in the CO_2 reading. He should then know that he must increase the coal feed to that section.

From this discussion, it should be obvious why men should not be allowed to use slice bars or other firing tools to level up the fuel bed. When their stoker is not feeding correctly, it should be adjusted. Firing tools disturb the bed and mix ashes in with the hot coal to cause clinkers, and obviously do not correct the source of the poor distribution. When ash is allowed to sift down to the bottom of the bed, out of the hot burning zone, it will not clinker. Moreover, it will be available to insulate the metal grates and tuyeres. It should be noted that temperatures at the top of the bed usually exceed the melting point of the ash as well as that of the cast iron grates and tuyeres.

Some types of ash will soften and form a clinker at temperatures of 2000 F to 2200 F. Cast iron softens at about the same point. But, down around 600 or 700 F, it will start to lose strength and to oxidize rapidly and to take on a permanent expansion known as metal growth. The designers therefore, try to limit the metal temperatures to a maximum of 300 or 400 F for low maintenance. This is achieved by the cooling effect of the combustion air plus the insulating effect of the ash layer and the bed of coal which separate the grates from the hot coals on the top of the bed.

Naturally, clinkers will be formed if the bed is not properly maintained to avoid overheating the ash. It is true that some types of ash will stand more overheating than others. However, it is not for the operator to complain about the ash-fusion temperature but rather to correct his operating mistakes and burn the type of coal that the purchasing department finds to be economically available.

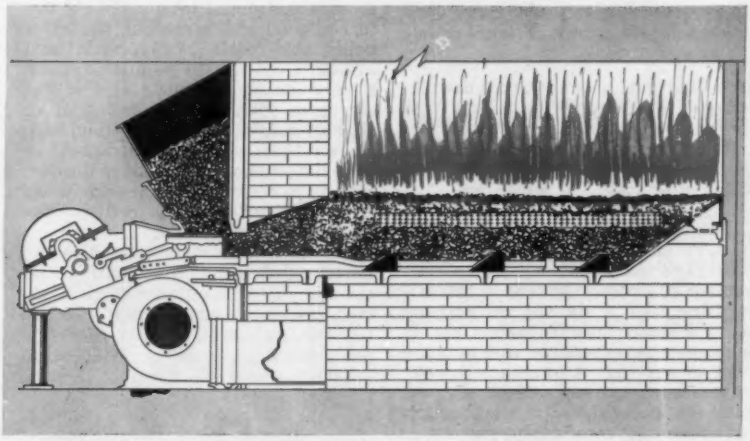


Fig. 2. Another type of single retort stoker. As with stoker in Fig. 1, coal is fed into furnace by ram, while the bed thickness is controlled by the distributing bar

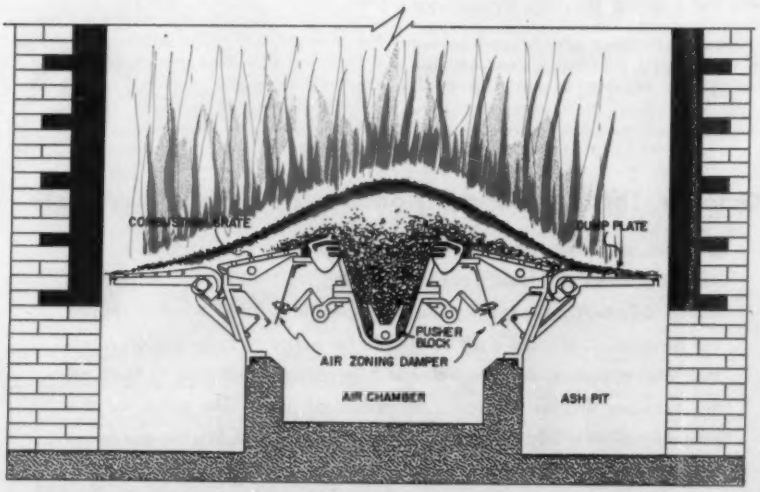


Fig. 3. Section through furnace shown in Fig. 1. As coal is pushed forward it travels sideways by gravity over the sloping combustion grates to the dump plates

Coal Application

Most designers today use sufficiently conservative heat-release factors to insure satisfactory use of any and all types of coal available to the plant, thereby permitting a wider coal selection and the opportunity to buy better coals at lower prices. In the old days, people talked about coal being of good quality if it had low ash content, high heating value, low sulphur and high ash-softening temperature, because these were the elements that minimized labor requirements and troubles in hand-fired plants. However, with conservatively designed stokers, the operators need not be concerned about how much ash there is in the coal but rather with the question of whether or not the ash content is uniform.

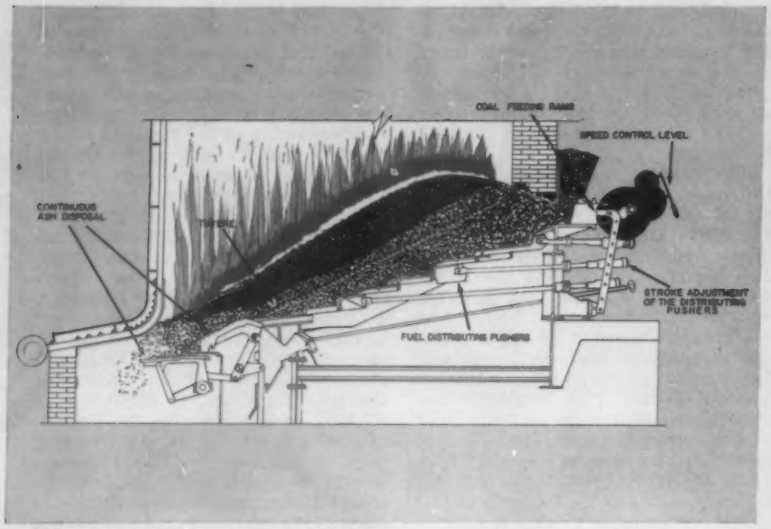


Fig. 4. Multiple retort stoker. Coal feed ram and distributing pushers operated by same connecting link, with separate adjustment for stroke of each pusher

If the characteristics are not uniform, it becomes necessary to make adjustments frequently. Comparing a load of coal containing 8 per cent ash with one containing 12 per cent ash, you can readily see that the operator must speed up the stoker for the latter coal. Similarly, one stroke of the ram will move a greater weight of fine coal than of coarse coal. It is much more important to have a coal that is uniform in characteristics than one that might have better characteristics but is not so uniform.

The uniformity is achieved through quality-control methods at the mines in much the same way that quality is controlled in other businesses. Immediately above and below a coal seam there is shale, rock, clay and other extraneous material that could get loaded out with the coal if the mining methods were not carefully supervised. Also, the seam itself contains mineral impurities known as ash which cannot be entirely removed from the coal, but which can be controlled to fairly close limits through various mechanical cleaning processes or careful hand picking before the coal is shipped.

Of course, in many very small mines, no attention is given to control of quality beyond hand picking some of the larger rocks and slate off the top of the car. But I am sure your purchasing department knows how to identify a good mine.

There are sometimes certain differences of opinion about the size of coal to use and the amount of fines that the coal should contain. Occasionally, I hear operating men referring to fines in coal as bug dust or dirt. This, of course, is not true. All stokers are designed to operate best with a certain percentage of fines, because coarse coal on a fuel bed leaves too many voids and makes it harder for the operator to control his fires. It is true, of course, that double-screened coal is easier to unload from the cars and therein lies the big attraction in cases where the handling facilities might be inadequate.

Coal Handling

For cold climates, there are inexpensive car thawers and for year-round use there is an inexpensive car shaker to minimize trouble in unloading fine coal. I do not recommend using a steam hose to thaw a car. It is dangerous, expensive, and gets the coal so wet that it plugs up the elevator buckets and sticks in the bunkers and chutes. If the buckets do not empty completely, you are in for elevator trouble just the same as if you were feeding coal to the elevator faster than it carries the coal away. The surplus builds up in the elevator boot and the buckets coming around will have to dig through the pile-up of coal.

Your conveyors are rugged pieces of equipment especially designed for the tough service of moving coal. But, like anything else, they will not give good service unless they are properly operated, and the parts inspected and lubricated at regular intervals. Both designers and operators are sometimes inclined to treat the coal and ash-handling systems as sort of a step-child and, in such cases, it frequently happens that the handling systems become the most troublesome element in the plant.

Acid Formation

There are a few simple but not too well publicized rules which are important to achieving good service life of handling equipment. First, conveyors subject to erosion should not be operated at any higher speed than necessary and also provision should be made on such things as flight and bucket conveyors to keep the chains out of the coal. Belts cause trouble if they are too narrow for proper troughing or too slow for limiting the load on the belt. The elements of erosion and metal fatigue should not be confused with corrosion, the latter being the result of sulphuric acid attack. Contrary to popular opinion a very strong sulphuric acid is less corrosive than a dilute solution so that we need not be so concerned with the strength of the sulphuric acid as with the amount of acid being formed. Efforts to control the moisture in the coal will effectively reduce the amount of acid formed.

There is a relation here also between sulphuric acid formation and the danger of spontaneous combustion, because when sulphur oxidizes to SO_3 and combines with water to form sulphuric acid, a considerable amount of heat is generated. In storing coal in large outdoor piles, we do not worry about the sulphur but simply make sure that the ground is well drained so that there is not a lot of water to react with the sulphur. We also compact the coal to keep down air infiltration except in the case where we are storing double-screened coal which has enough voids for unrestricted ventilation and dissipation of any heat generated by the chemical reactions.

October Through March Handbook Reprints Available

Reprints of POWER ENGINEERING Handbook are now available. The reprint includes all those pages appearing from October '54 through March '55, and an index for locating specific articles. Another reprint will be made available each six months hereafter to help readers keep their files complete, and the index will be revised each time to keep all the previous articles in proper alphabetical order. The price for the present reprint is 25¢ per copy, or five copies for $1.00. No provisions for imprinted 3-ring binders have been made yet, but will be made later.

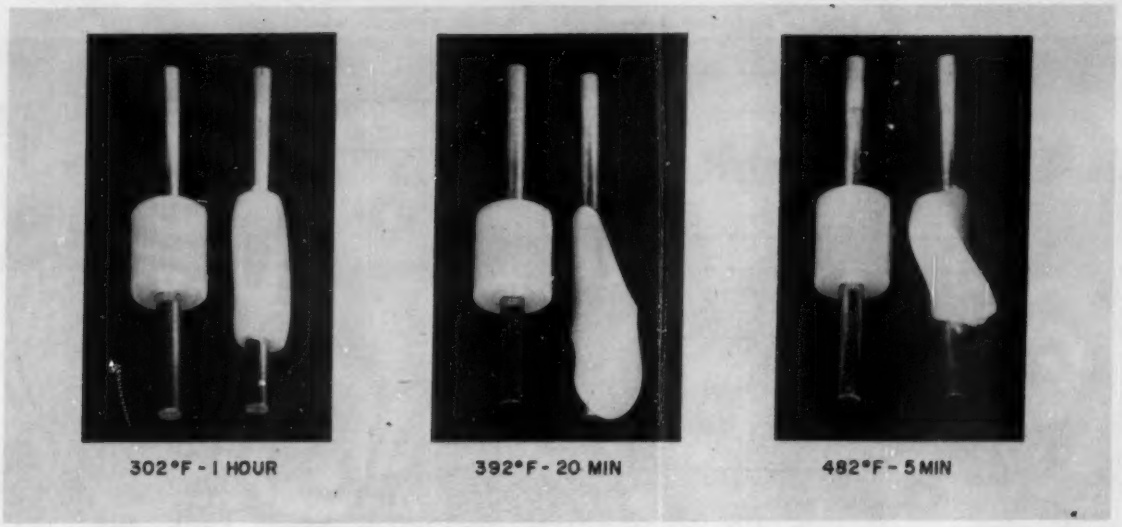


Fig. 1. Irradiated polyethylene's advantages are apparent in this test. Ordinary polyethylene is on right, new tape, left

Irradiated Polyethylene Used for Hot-Spot Electrical Insulation

When polyethylene plastic is bombarded with Beta radiation (or hi-energy electrons), its excellent insulating properties are moved up a notch on the temperature scale. Recent research has given the engineers the data they need to design this material into products

Fig. 2. Blowout coil with new plastic insulation on turns, glass tape outside

Fig. 3. J. R. Stirrat of G-E holds strip of the irradiated polyethylene insulation

More complete information on the properties of this material can be obtained by writing "Plastic Film" on the postcard to be found elsewhere in this month's issue.

POLYETHYLENE offers the electrical designer a tough insulation which has flexibility, low specific gravity, chemical inertness, negligible water absorption, high dielectric strength, and low loss at all frequencies. Until recently, there was just one problem: Heat it up a couple of hundred degrees and it would melt.

Recent experiments in radiation chemistry (a far cry from power engineering) have offset this disadvantage. Irradiation of polyethylene with high-energy electrons made it nonfusible without reducing the highly desirable properties previously listed. One company has quickly developed an insulating film for use by the electrical industry and has already applied it to products of its own manufacture. Pilot-plant quantities of this film are now available to other firms.

One application of the film (to the best of our knowledge, the only application to date) is in the blowout coil windings of an air-magnetic circuit breaker. While the entire coil is encased in a layer of glass tape for overall protection, the individual turns are wound in the irradiated polyethylene tape. Where the material is in contact with both copper *and* air, continuous operation is not recommended above 100 C; however, where the plastic is protected from air by adjacent windings or overlayers of other materials, the plastic should operate well above Class A insulation temperatures. Brief overload temperatures of 200 C can be tolerated in the windings without flow or decomposition.

This particular irradiated polyethylene undergoes a transition at the melting point of conventional polyethylene (about 110 C). Above that temperature it is a rubber; it is claimed, in fact, to be very nearly an ideal rubber. It will deform in proportion to an applied load, but only to a limited extent, and will return to the original dimensions when the load is removed. Basically, it is an elastic (not plastic) deformation.

Applications suggested for this insulation very nearly cover the full range of electric power apparatus. For example, wire and cable, motors and generators, transformers, coils, capacitors, and moisture barriers for composite insulations are all being considered. To the best of our knowledge, as previously mentioned, the air-magnetic-type circuit breaker is the first actual application. To engineers who have observed the extremely slow and deliberate evolution of commercial applications for similar new materials, this must seem like prompt work indeed.

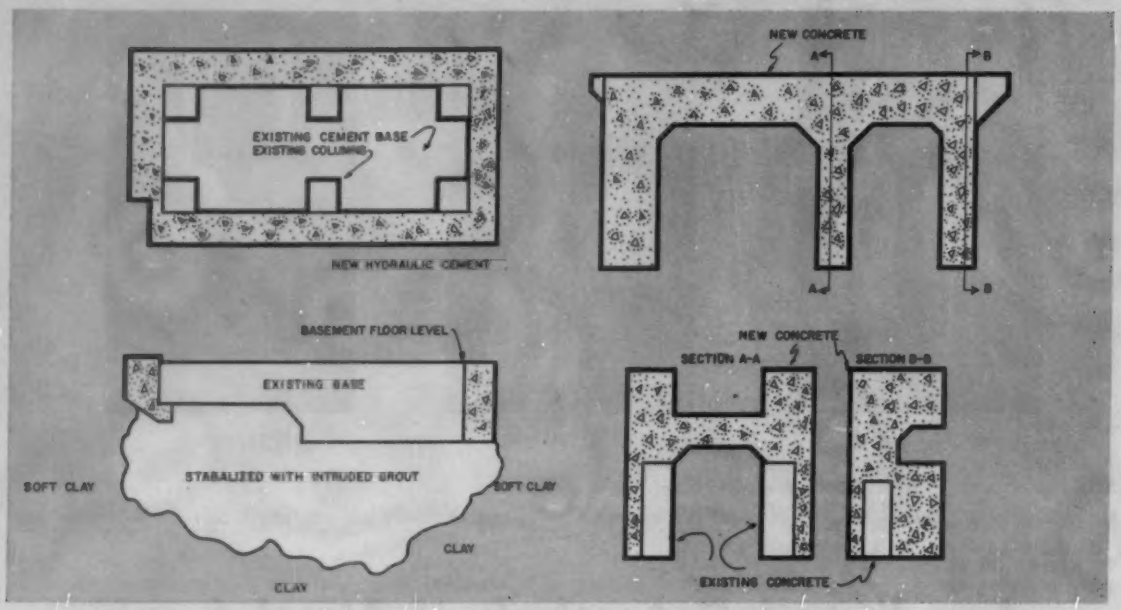


Fig. 1. General layout of foundation for new turbine showing how new structure incorporates columns from old foundation

Hydraulic Cement Method Speeds

Hydraulic cement method described here for building new structure round existing turbine foundation should have many applications where a unit has to be replaced by a larger one in same location

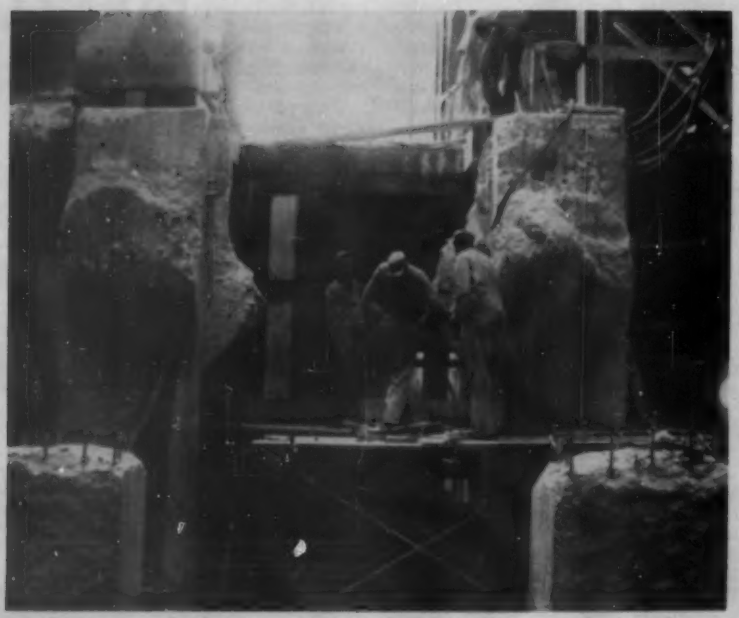


Fig. 2. These columns, part of old turbine foundation, were badly deteriorated. They were stripped down to good solid concrete before use in new structure

By H. NYE JOSLEYN

GOOD EXAMPLE of hydraulic cement procedure for simplifying difficult construction was the rebuilding of a turbine foundation at Madison Gas and Electric Company's station at Madison, Wisc. The problem was the installation of a new 30,000 kw steam turbine to replace one of 15,000 kw capacity at the Blount Street Station.

The methods used for this job were shown to be ideal for building new structures as well as modifying old ones. Much out-of-service time was eliminated by doing considerable work before it was necessary to shut down the old turbine. Advantages were in solidifying the underlying fill; thorough binding of old concrete with the new; and in the comparative ease of placing new concrete around dense steel reinforcement.

The old foundation was found to be resting on soft clay some 13 ft below lake level. To support the increased load, the soil was impacted and solidified by the intrusion use of hydraulic cement under pressure. Approximate position of this work is shown in Fig. 1. The base was then enlarged by

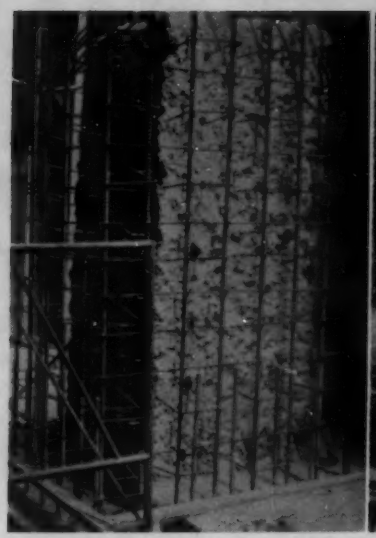


Fig. 3. Remains of old column, seen through the reinforcing mesh, formed part of the fill for the new structure. Note heavy reinforcing for new foundation

Fig. 4. Stripping forms from top section of new foundation. This hydraulic cement method gives a very high bond strength between the old and new concrete

Fig. 5. View taken below new foundation, showing size of columns and finish obtained with this method. Much of the work was done while turbine was running

Turbine Installation

placing 18 foundation blocks around the old mat using a total of about 150 cu yd of concrete. The concrete was made by evenly placing a coarse cracked aggregate into the forms and then forcing the liquid mortar into all the voids. The result was an effective high strength bond of the old concrete with the new to form a dense monolithic base for the new turbine. This part of the work was done with no interruption in operation of the old turbine.

Specifications for the new installation also called for enlarging the existing support columns and beams, as shown in Fig. 1. In the interests of economy portions of the old structure, some of which were badly deteriorated, were cleaned down to good solid concrete (Fig. 2) and left in place to act as partial fill inside the new forms. Heavy reinforcing, as shown in Fig. 3, was necessary to achieve the desired load. The hydraulic method, in contrast to conventional concrete, greatly facilitated the placing of a good quality high strength concrete around intensely packed reinforcing rods and in irregularities of the existing concrete.

Before the aggregate was placed in the forms, pipes through which the grout was to be pumped were inserted down among the reinforcing rods. As the work progressed these pipes were gradually raised to be entirely removed before the concrete hardened. Approximately 210 cu yds of hydraulic concrete were used to provide an efficient stable superstructure for Madison's new turbine.

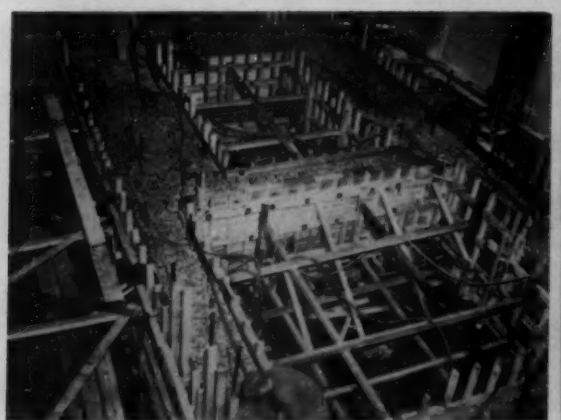


Fig. 6. Top section with aggregate ready for pressure grouting. Grout pipes are inserted in aggregate at 5 ft intervals

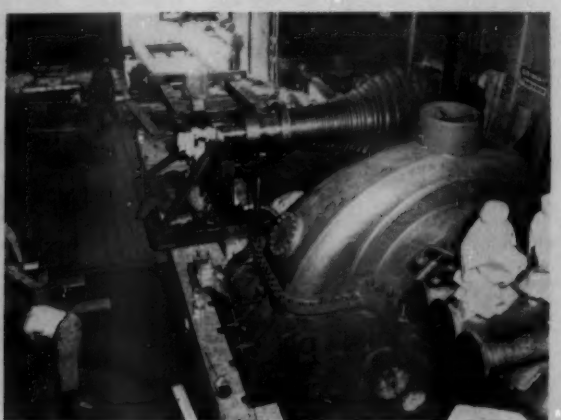


Fig. 7. New and larger turbine being installed. The foundation is complete except for final grouting in of machine

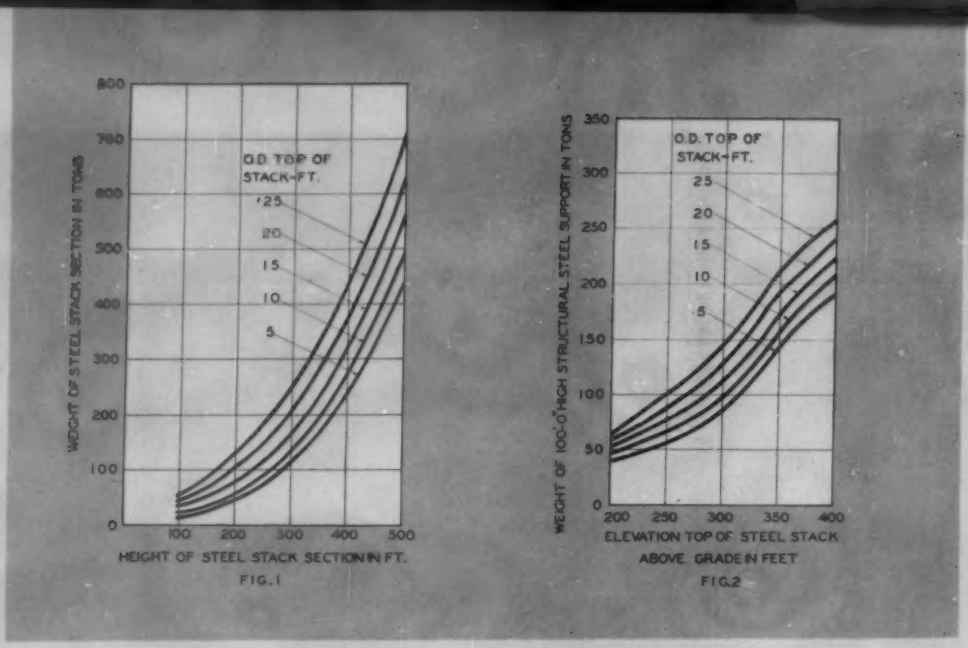


Fig. 1. Weight of steel in stack sections with OD at any section not less than one eleventh the height of stack above that section. Fig. 2. Weight of supporting steel for a steel stack mounted on a 100-ft-high building or independent tower

How Much Do High Stacks Cost?

Large modern boilers produce staggering quantities of gas and ash which must be dispersed. Higher stacks help, but they cost plenty. These charts and discussions help you determine the economic design criteria, choose brick, concrete or steel, and compare costs

By **E. J. STANKIEWICZ***

RAPID GROWTH in power requirements during the past decade has resulted in the development of high pressure boilers which in many instances have over ten times their previous maximum capacities. The greater concentration of flue gases from these larger boilers has presented a new problem regarding the satisfactory dispersion and dilution of the products of combustion. In most instances the problem has been solved by increased stack heights. The increased cost for the greater stack heights requires a careful evaluation of the comparative costs for the various types of stack construction.

When the initial plans and studies are being made for the installation of a new boiler, information on the comparative costs of the various types of stack construction is very helpful in making decisions regarding the size and location of the stack, as well as the location of the auxiliary equipment and flues. The accompanying charts give material quantities for use in obtaining *comparative* initial costs for steel, brick and concrete stacks.

Material quantities for steel stacks are given in Figs. 1 to 4, inclusive. The weights of steel stack sections given in Fig. 1 are based on nominal plate weights plus 15 per cent to allow for Tee bars or shelf angles, welds, coping, ladder, base connection and anchor bolts, allowable overweight of plates, material lost in fabrication and paint. The stack plates were designed to support a 5-in.-thick brick lining and no additional plate thickness was allowed for corrosion. The unit cost per ton of stack section will range from $450 to $600.

Figure 2 is for use in obtaining average estimated weights of structural steel required to support a steel stack on the roof of a 100-ft-high building or a 100-ft-high independent steel tower. The estimated weight of structural steel to support a steel stack on the roof of a 150-ft-high building or a 150-ft-high independent steel tower is equal to the increase in weight for the 150 ft greater height of stack section.

For example, the weight of a 150-ft-high structural steel support for a 300-ft elevation top of stack above grade is obtained from Fig. 1 by taking the difference in weight between a 300-ft and a 150-ft-high stack section. The unit cost per ton of structural steel will range from $260 to $300. Figure 3 gives the cubic yards of concrete for steel stack foundations. The unit cost per cubic yard, including excavation, formwork and reinforcing steel, ranges from $35 to $45.

Figure 4 gives the surface area of linings attached to the steel stack plates. When the breeching connection is located a considerable distance above the base of the stack, a false bottom protected with a lining and located immediately below the breeching opening is recommended rather than lining the "dead" space at the bottom of the stack. The unit cost per square foot for a 5-in.-thick brick lining consisting of a 4-in.- thickness of vitrified paving brick and 1-in.-thick silica sand mortar backing ranges from $2.25 to $2.75 for Lumnite cement and $2.00 to $2.40 for Portland cement. The unit cost per sq ft for a 2½-in.-thick silica sand gunite lining (including reinforcing) ranges from $1.60 to $1.90 for Lumnite cement and $1.25 to $1.50 for Portland cement.

Material quantities for determining the estimated costs of radial brick

* Chief Structural Engineer, Sargent & Lundy, Engineers, Chicago 3, Ill. The material quantities and cost data for brick and concrete stacks were furnished by the Custodis Construction Company. The data on steel stacks were prepared by Messrs. W. Millard and A. C. Rasmussen of Sargent & Lundy.

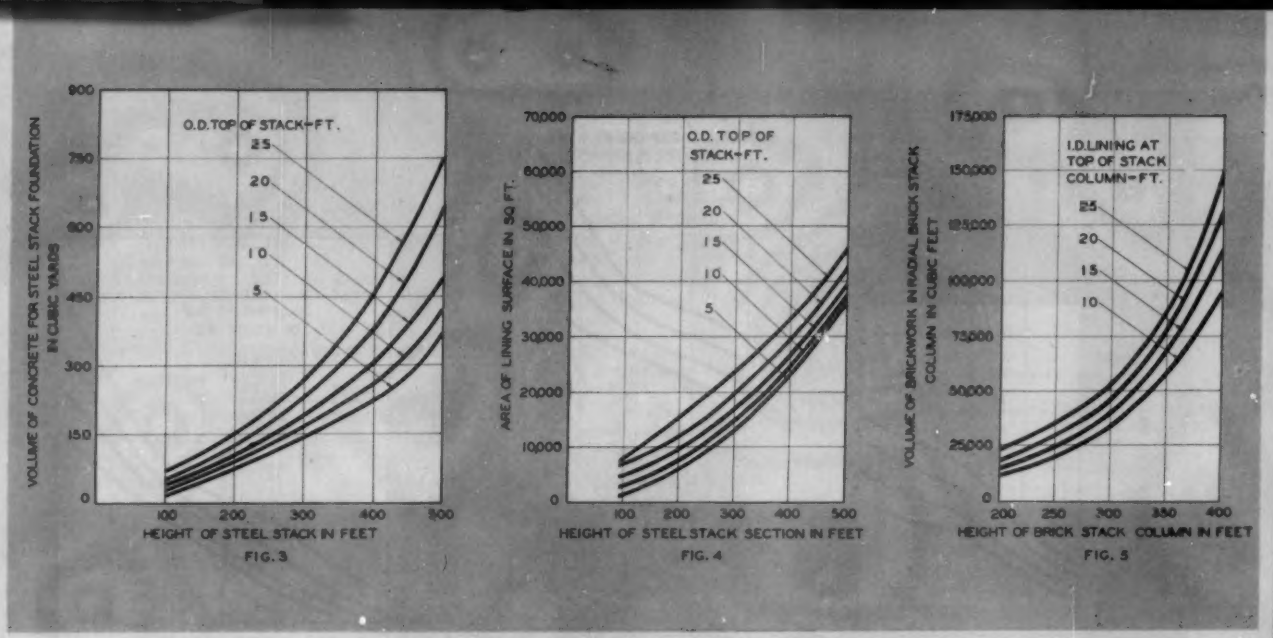


Fig. 3. Volume of concrete for steel stack foundations (6000 lb per sq ft soil pressure). Fig. 4. Steel stack liner area for sections proportioned as in Fig. 1. Fig. 5. Brick volumes for radial brick stack columns at 200 psi loading, 600 F gas

stacks can be obtained from the charts in Figs. 5 to 7 inclusive. Figure 5 gives the volume of radial brickwork for stack columns. The unit cost per cu ft for the radial brick stack columns (which includes mortar, step irons, cast aluminum air vents at top and bottom of each lining section, concealed steel reinforcing bands, cleanout door, lintels above breeching and cleanout doors *but does not include* steel breeching frames, bronze rail for obstruction lighting, lightning protection system and cast iron cap covering stack column and lining) ranges from $1.90 to $3.50. Figure 6 gives the volume of radial brickwork for the stack linings. The unit cost per cu ft for the radial brick linings, including Portland cement-lime mortar, ranges from $2.25 to $3.70. Figure 7 gives the cubic yards of concrete required for brick stack foundations. The unit cost per cu yd, including excavation, formwork and reinforcing steel, ranges from $35 to $45.

The material quantities for determining estimated costs of concrete stacks can be obtained from the charts in Figs. 8 to 10 inclusive. Figure 8 gives the volume of concrete for concrete stack columns. The unit cost per cu yd of concrete (including reinforcing steel, ladder and cleanout door but *not* including lightning protection system and cast iron cap covering stack column and lining) ranges from $75 to $135. Figure 9 gives the volume of hard burned shale brickwork for the concrete stack linings. The unit cost per cu ft for the lining brickwork (including Portland Cement mortar and the cost of providing 2 in. of insulation or a 2-in. dead air space) ranges from $3.50 to $4.25. Figure 10 gives the cu yds of concrete required for concrete stack foundations. The unit cost per cu yd including excavation, formwork and reinforcing steel, ranges from $35 to $45.

Comparative initial costs for steel, brick and concrete stacks will vary depending on material and labor costs and freight rates for different localities, as well as the variations in a given locality due to current price changes. Maintenance charges for each type of stack construction will vary with local climatic conditions, flue gas temperatures, type of fuel, frequency of boiler outages or periods of partial loads, materials of construction and workmanship. Each type of stack will have certain advantages such as a more economical flue gas duct arrangement for a steel stack supported on a boiler room roof or the utilization of the lower portion of a brick or concrete stack as an ash hopper.

Unit prices for estimating the initial costs of stacks in a particular locality can be obtained from the known costs of existing stacks, by assuming an estimated price range for each class of material, or by a combination of these methods. A typical example for a radial brick is as follows:

Find the initial cost of a 10-ft top ID by 300-ft-high radial brick stack including foundation. Available cost data: Existing 14-ft-6-in.-top ID by 275-ft-high radial brick stack recently cost $136,900, not including cost of the concrete foundation. Cost of brickwork in the locality is above average. Material quantities for 14-ft-6-in.-top ID by 275-ft-high stack column and lining are as follows:

30,000 cu ft of brickwork in column (Fig. 5).
8,500 cu ft of brickwork in lining (Fig. 6).

Range of unit prices for brickwork are:

$1.90 to $3.50 per cu ft for brickwork in column.
$2.25 to $3.70 per cu ft for brickwork in lining.

By trial and error substitution we find the actual unit prices for brickwork are 100 per cent of the highest unit costs given in the price range.

30,000 cu ft × $3.50 =	$105,000
8,500 cu ft × $3.70 =	31,450
	$136,450

The initial cost of a 10-ft-top ID by 300-ft-high radial brick stack, including cost of the concrete foundation based on average costs for concrete work, will be as follows:

33,500 cu ft ×	$3.50 =	$117,250 Column
8,500 cu ft ×	$3.70 =	31,450 Lining
250 cu yds ×	$40.00 =	10,000 Foundation (Fig. 7)
		$158,700

A typical example to determine the initial cost of this stack constructed of reinforced concrete is as follows:

Available cost data: Average unit prices for concrete work, brick lining costs are 100 per cent of the highest unit prices. The initial cost of a 10-ft-top-ID by 300-ft-high reinforced concrete stack including cost of foundation will be as follows:

470 cu yds ×	$105.00 =	$49,350 Column (Fig. 8)
5200 cu ft ×	$4.35 =	22,100 Lining (Fig. 9)
170 cu yds ×	$40.00 =	6,800 Foundation (Fig. 10)
		$78,250

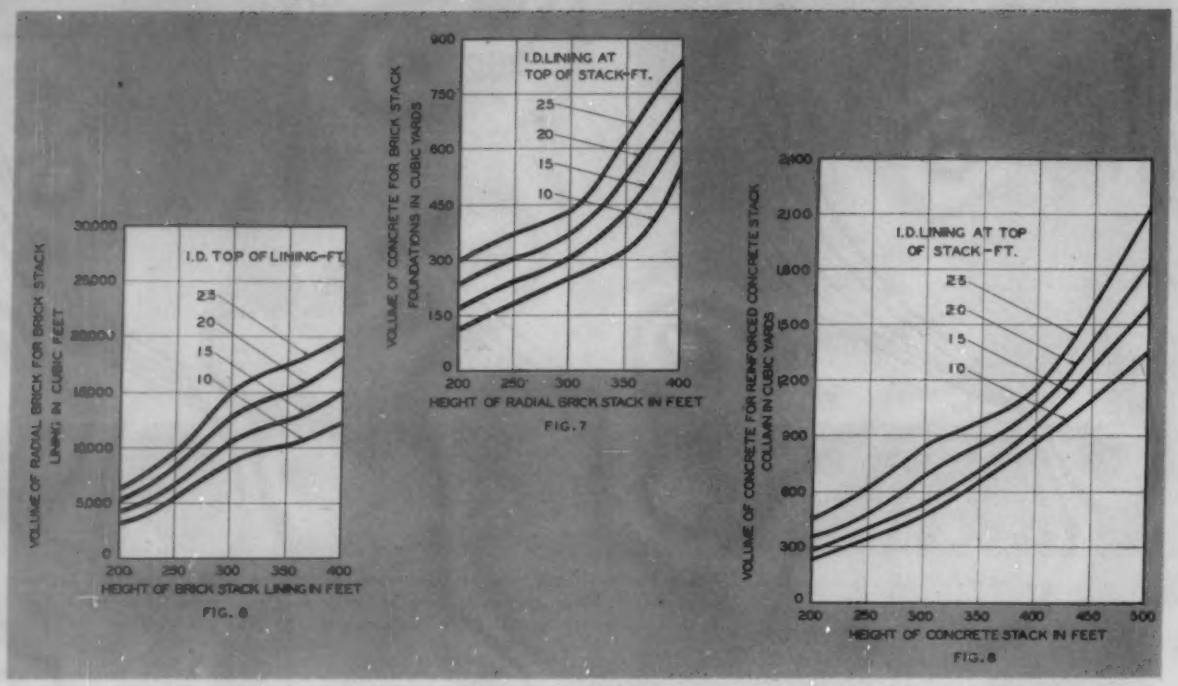


Fig. 6. Volume of radial brickwork for brick stack linings. Fig. 7. Volume of concrete for radial brick stack foundations (6000 lb per sq ft soil pressure). Fig. 8. Volume of concrete for brick-lined concrete stack (ACI Std Spec 505–54)

A typical example to determine the initial cost of the above stack constructed of steel and lined with vitrified paving brick laid in Lumnite silica sand mortar is as follows:

Available cost data: Average unit price for steel stack plates, brick lining costs are 100 per cent of the highest unit prices. The initial cost of a 10-ft-top-ID by 300-ft-high steel stack, including cost of a 5-in.-thick brick lining and concrete foundation, will be as follows:

140 tons (Plates (Fig. 1)	× $525.00 =	$ 73,500	Stack
15,000 sq ft (Fig. 4)	× $2.75 =	41,250	Lining
173 cu yds (Foundation (Fig. 3)	× $40.00 =	6,920	Foundation
		$121,670	

The following typical examples illustrate the procedure for obtaining comparative initial costs for a 10-ft-top-ID steel stack supported on the roof of a 100-ft-high building and having elevation top of stack 300 ft above grade. Cost to include 5-in.-thick paving brick lining laid in Lumnite silica sand mortar and concrete foundation.

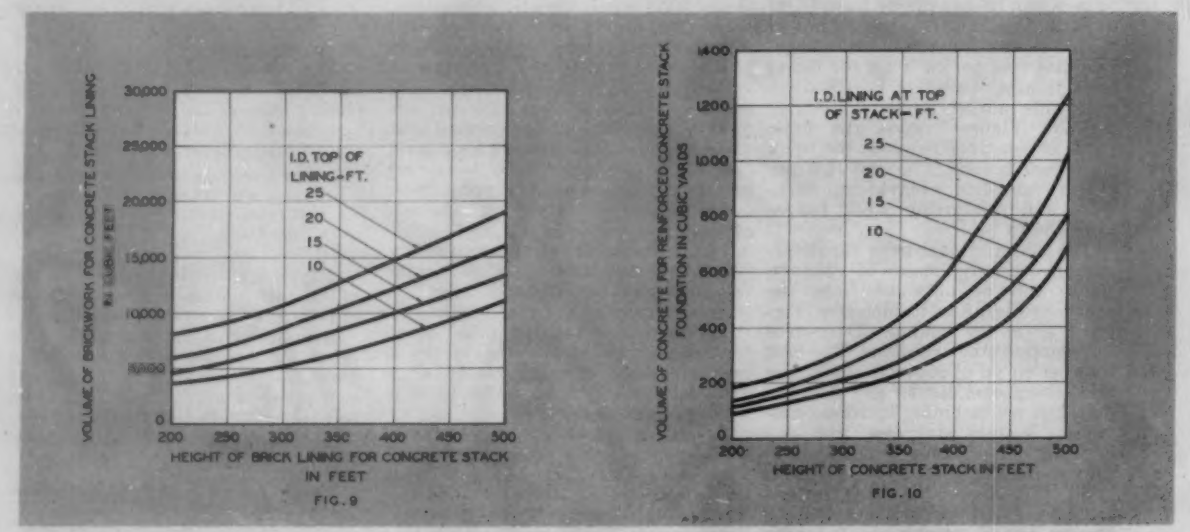


Fig. 9. Volume of brickwork for reinforced concrete stack linings. Fig. 10. Volume of concrete for reinforced concrete stack foundations based on 6000 lb per sq ft soil pressure. Note that diameters in Figs. 5–10 are ID (ft) at top of stack

Available cost data: Average unit prices for steel stack plates, structural steel members and concrete work. Brick lining costs are 100 per cent of the highest unit prices.

60 tons × $525.00 =	$31,500	Stack Plates
100 tons × $280.00 =	28,000	Structural Steel (Fig. 2)
8,000 sq ft × $2.75 =	22,000	Lining
173 cu yds × $40.00 =	6,920	Foundation
	$88,420	

Comparative initial costs of 10-ft-ID by 300-ft-high brick, concrete and steel stacks supported at grade and having the lower 100-ft portion of the lining omitted will be as follows:

Radial brick stack, lined full height =	$158,700
Volume of lower 100 ft of lining is 8,500 − 3,200 = 5,300 cu ft (Fig. 6) at $3.70 =	19,600
	$139,100
Concrete stack, lined full height =	$ 78,250
Volume of lower 100 ft of lining is 5,200 − 3,700 = 1,500 cu ft (Fig. 9) at $4.25 =	6,375
	$ 71,875
Steel stack, lined full height =	$121,670
Area of lower 100 ft of lining is 15,000 − 8,000 = 7,000 sq ft (Fig. 4) at $2.75 =	19,250
	$102,420

If the stack in the preceding example will not be subject to severe flue gas corrosion due to the use of low sulphur fuels and favorable operating conditions, the steel stacks could be lined with a 2½-in. thickness of Portland cement-silica sand gunite lining with a possible reduction in lining costs amounting to $1.50 per sq ft. On this basis the initial cost of the steel stack will be as follows:

Stack on roof, brick lining	$ 88,420
Reduction in cost for gunite lining = 8,000 sq ft ($2.75 − $1.50)	10,000
	$ 78,420
Stack supported at grade and lower 100 ft height of brick lining omitted	$102,420
Reduction in cost for gunite lining = 7,000 sq ft ($2.75 − $1.50)	8,750
	$ 93,670

Maintenance charges for the different types of stack construction can be obtained from available cost data on maintenance and repairs to similar stacks. The following example illustrates a typical method for adjusting the initial costs obtained in the preceding examples to provide for maintenance charges.

Available cost data: Based on total initial stack costs, the capitalized value of annual maintenance averaged over a 30-year period has been found to be 8 per cent for a brick stack, 15 per cent for a concrete stack and 3 per cent for a steel stack in the particular locality under consideration.

Initial cost of brick stack =	$139,100
Maintenance charge $139,100 × .08 =	11,128
	$150,228
Initial cost of concrete stack =	$ 71,875
Maintenance charge $71,875 × .15 =	10,781
	$ 82,656
Initial cost of gunite lined steel stack on roof =	$ 78,420
Maintenance charge $78,420 × .03 =	2,353
	$ 80,773

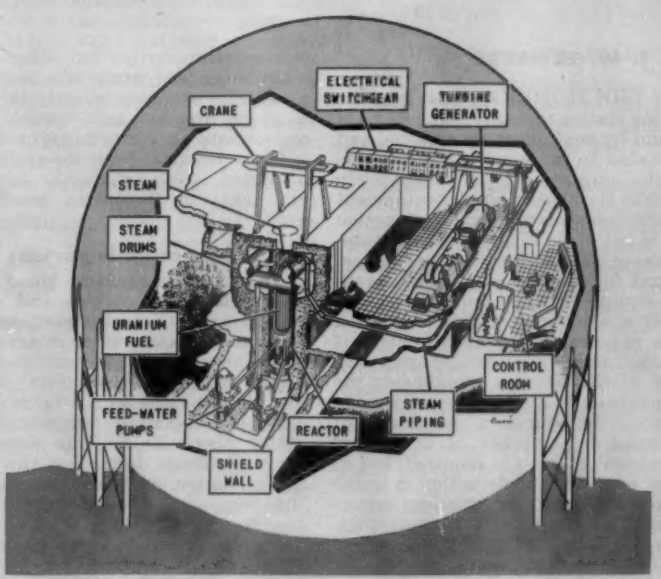
These comparative costs for concrete and steel stacks require further evaluation to determine the comparative costs for the flue gas ductwork, the possible utilization of the lower portion of the concrete stack as a storage hopper, architectural appearances, length of time required for construction and flexibility for future alterations and extensions.

Material quantities and cost data in this article are intended only for use in evaluating the *relative comparative* costs for various types of stack construction and not for obtaining the actual dollars-and-cents cost of a particular stack.

Boiling Water Atomic Power Plant for Chicago

COMMONWEALTH EDISON Company together with other associated companies in the Nuclear Power Group has announced plans to build a full-scale nuclear power plant at a site about 47 miles southwest of Chicago. The proposed plant will have an installed capacity of 180,000 kw and will use a boiling-water type of nuclear reactor, developed at Argonne National Laboratory.

This plant, the largest *all-nuclear* station yet scheduled, is sponsored by the Nuclear Power Group, and will be owned and operated by Commonwealth Edison Co. General Electric Co, as the prime contractor, will build the plant. G-E has contracted to build the plant for $45,000,000, a price considered to be very favorable. Commonwealth Edison will pay $30,000,000 toward the contract price. This, plus $500,000 representing the cost of the plant site, plus overhead, is proposed to be included in Edison's utility plant account. On this basis (which thus excludes $15,000,000 of the total cost) it is estimated that the nuclear plant will produce electricity at a per kilowatt cost approximately competitive with new coal-fired generating units in Edison's service area. If the proposal is accepted by AEC, the Bechtel Corporation will act as engineer-constructor for General Electric.



Artist's drawing showing a cut-away view of the 180,000-kw nuclear power plant proposed by the Commonwealth Edison Company for the Chicago area. The boiling-water reactor, turbine generator and related equipment will be enclosed in a steel sphere about 200 ft in diameter. In the boiling-water reactor steam used by the turbine is generated directly in the nuclear reactor itself. This eliminates all need for intermediate heat exchangers, thus reducing investment costs

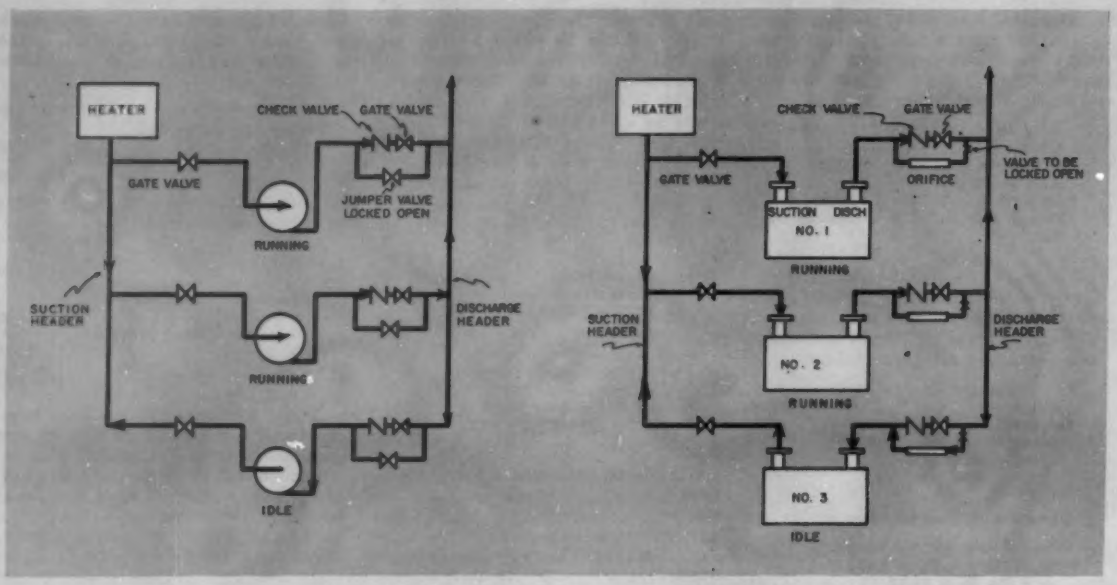


Fig. 1a. *(Left)* Arrangement of equipment for maintaining continuous warm-up of low-pressure pumps. Fig. 1b. *(Right)* Use of reducer with high-pressure pumps

Is Your Standby B-F Pump Warmed Up,

Standby equipment is for emergencies—and emergencies, by definition, call for immediate action. Here are measures you can take to be sure that your standby B-F pumps are ready to go—instantly

By T. W. EDWARDS*

IN THE MODERN steam generating station there are many items of stand-by equipment all designed and installed to serve one, and only one, useful purpose. They are there solely to take the place of similar equipment which unexpectedly fails to function or is out of service for routine maintenance. Therefore, in order to account for itself properly, this standby equipment must be ready to take over at a moment's notice — not in a few minutes, nor in a few hours, but immediately. Frequently, upon failure of the primary equipment, the conversion to stand-by is fully automatic. Sometimes a minimum of manual manipulation of valves and electrical controls is required; but in any case, immediate action is essential, and failure of stand-by equipment to operate properly upon start-up can cause costly dropping of load and system disruption.

Although many units within the station are provided with stand-by equipment, the main boiler feed pumps are probably the most important. A heater drain pump can usually be by-passed and the drains cascaded to a lower pressure heater; a closed heater can be taken out of service temporarily; but when the main boiler feed pump fails, another must take over immediately or load must be dropped and possibly the main steam generator brought down without delay. At best, the system is disrupted, at worst, costly damage can occur in the steam generator itself.

Temperature Important

The fact that stand-by boiler feed pumps must be valved and electrically wired to start immediately is obvious. However, there is an additional important matter which must be attended to — stand-by boiler feed pumps must be up to, or very close to, operating temperature — within about 20 F. Only then can they effectively take over the load in a minimum period of time without the possibility of damaging themselves upon start-up.

If a boiler feed pump stands at room temperature and then is called upon unexpectedly to take load, the transition from low to high temperature can occur in a very few seconds. In high pressure installations, this change in temperature can be 300 F or more. Thin sections within the pump, such as impellers, tend to heat up much more rapidly than heavy sections, such as casings. Therefore, their rates of thermal expansion are much greater and considerable distortion can result. If this distortion is great enough, internal clearances can be reduced to zero and internal contact takes place. With the materials of construction required by use of modern boiler feed waters, the slightest contact between rotating and stationary parts can cause immediate seizure. Even if actual seizure does not occur on one occasion, there is no assurance that it will not occur the next time, nor is there any doubt that an abnormal amount of wear has taken place in the running clearances during the moment of contact.

In certain designs, the degree of tightness of impellers on the shafts is a function of temperature. If impellers and shafts are of materials with widely differing coefficients of expansion, impeller fits can be loose when cold. Starting under these conditions can cause serious damage. There are however, certain designs of boiler feed pumps which are capable of withstanding cold starts, but this ability should be relied upon only when an extreme emergency condi-

*Application Engineer, Centrifugal Pump Div., Worthington Corp.

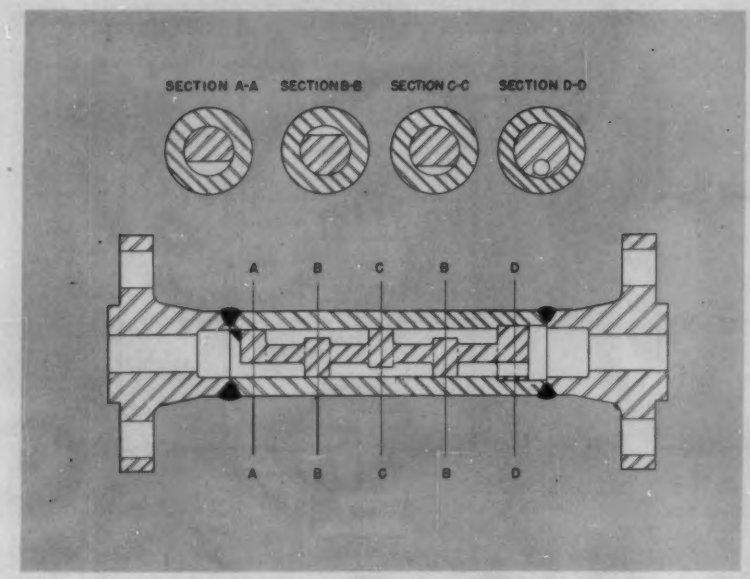


Fig. 2. One form of the multiple pressure reducing orifice is shown here. This unit is a patented device of the author's company; other types are available

Ready to Run?

tion exists. Under normal conditions, any boiler feed pump should be brought nearly to running temperature before it is started up.

There is one additional important caution which should be exercised in this connection. If there is anything worse than starting a cold boiler feed pump, it is starting one that is partly hot and partly cold. When flow insufficient to fully warm up the pump has taken place, the water within the pumps tends to stratify as to temperature, and the pump becomes hot at the top and cold at the bottom. Under these conditions, severe distortions and thermal strains exist to the point where internal contact almost surely will result. To start such a pump under these conditions will cause severe internal damage, and the risk of immediate seizure is extremely high.

Warm-Up Methods

Let us look at the various means available to the operator to assure successful start-up by keeping his stand-by boiler feed pumps hot at all times.

In a small installation, say for a 100-lb boiler, the simplest method is to allow a small flow through one of the pump drains.

In such a system, the suction and discharge gate valves are left open; the check valve, of course, is closed. A small valve is installed at one of the pump drains and is opened a small amount. Hot water under suction pressure is allowed to flow through this valve to waste, or reclaimed to a make-up or storage tank. The method is inexpensive and effective, but can constitute a waste of boiler feed water and requires manual operation.

A refinement of this method is the installation of a small jumper line around the discharge gate and check valves. See Fig. 1a. When the particular unit involved is on stand-by service, the check valve is closed. The suction and discharge gate valves and the small jumper line throttle valves are open. Reverse flow then takes place through the jumper line through the pump and into the common suction header. Since the pressure differential in such an installation is low, the throttle valve controlling the flow through the jumper line will probably not be subject to uneconomically high rates of wear.

To assure himself that this method of warm-up is constantly in operation, the operator may open the jumper line throttle valve permanently and remove the valve hand wheel. Thus, when idle, the reverse warm-up flow through the pump is assured; when running, the presence of this open valve has no adverse effect since practically no flow will occur through it.

In installations of higher pressure, where the pressure to be broken down through the jumper line is considerable, abnormally high wear through the jumper throttle valve itself would be experienced were not special measures taken to eliminate this wear. Under these conditions, it is advisable to provide a specially designed breakdown orifice to reduce the pressure to suction pressure. (See Figs. 1b and 2.) In this case, the quantity of hot water flowing back through the idle pump is controlled by the design of the orifice itself. No throttling valves are used.

It should be borne in mind in both of these cases that the amount of flow to be allowed is not subject to simple calculation. Rather, it must be determined experimentally. Usually the pump manufacturer can provide this data based upon his past experience. Too little flow will not be effective in keeping an idle pump close to running temperature since it will not overcome the effects of radiation. Too much flow is an unnecessary waste.

There are many additional factors which should be taken into account in determining the effective, but at the same time, economical pump flow. Is the pump insulated and lagged? Is the difference between running and ambient temperature large? A good value to use for preliminary purposes would be between 3 to 7 gpm. The 3-gpm value applies to the small capacity, moderate head, industrial boiler feed pump; the 7-gpm value applies to large capacity, high head, central station units. At best, these values are very approximate and are based upon a continuous warm-up process. Occasionally it is desirable to warm-up a cold pump which may have been completely out of service. In such cases, a warm-up period of 30 minutes should suffice.

Other Means Available

With certain pump constructions there is another method of warm-up available to the station operator. Some high pressure boiler feed pumps are provided with a balancing device designed to reduce or eliminate hydraulic thrust in the pump. Flow takes place through this balancing device which is normally piped externally to the pump and back to the deaerating heater in an open cycle. As shown in Fig. 3a, the leak-off from the balancing device on all operating and stand-by pumps can be headered, and an orifice installed at the heater shell to maintain a slight differential pressure in the header over the suction pressure. By leaving the line from the header to the stand-by pump open, reverse flow can be made to occur through it.

The orifice at the heater shell must be very carefully sized, however, to allow for several operating requirements. Since the flow through the balancing device leak-off varies only slightly with boiler feed pump flow due to varying total heads developed by the pump, the orifice size need not take into account special requirements due to variable load or variable speed operation. It must, however, produce a sufficient pres-

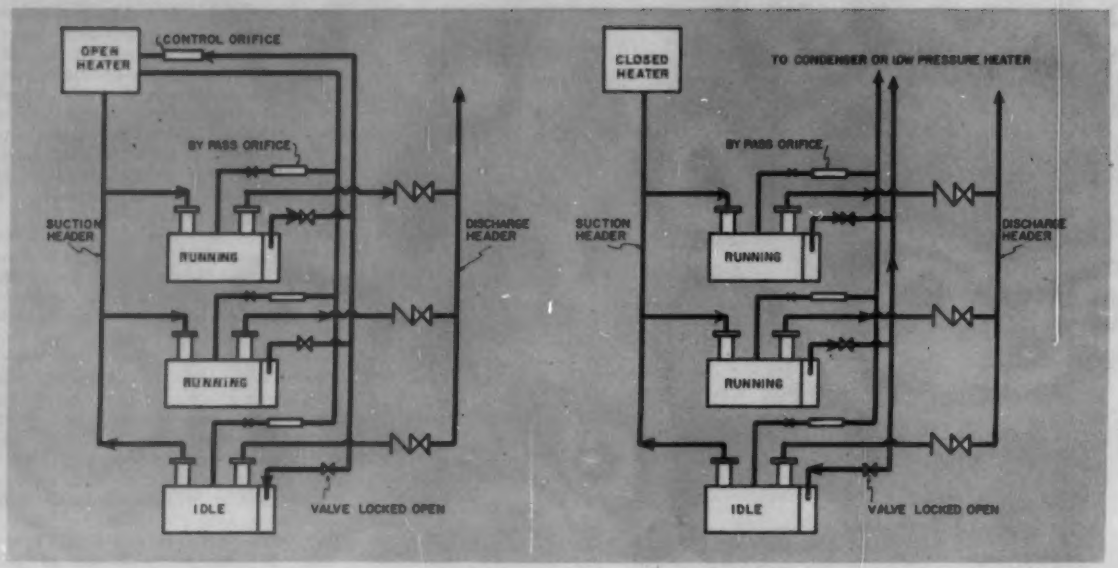


Fig. 3a. *(Left)* Special warm-up arrangement using balancing leak-off for an open cycle boiler feed pump system. Fig. 3b. *(Right)* Similar arrangement for warm-up of a closed cycle boiler feed pump system utilizing balancing device leak-off

sure differential over suction pressure to allow adequate reverse flow through the stand-by boiler feed pump. On the other hand, it must not produce so great a differential pressure as to jeopardize the proper operation of the balancing device itself. This would, of course, place an abnormally high load on main thrust bearings and shorten their life considerably. Also, too high a differential pressure would produce an uneconomically high flow through the idle pump.

Where this type of boiler feed pump is used in connection with a closed cycle, the balancing device leak-off can be carried to a low pressure closed heater or to the condenser itself. See Fig. 3b. Here again, the leak-off lines from the boiler feed pumps should be headered as previously mentioned. However, no orifice is required and flow will not be in the reverse direction since the balancing device leak-off is piped to a pressure lower than suction. Certain pump designs have this leak-off piped directly to pump suction individually, regardless of whether an open or closed cycle is involved. This is most frequently done in closed cycle operation. The above method, therefore, is not applicable unless pump construction is altered to allow for it.

If this last, rather special, arrangement is contemplated, the boiler feed pump manufacturer should be consulted and provided with full details concerning the physical layout of the feed-water system with pipe sizes and all other data necessary to analyze the set up completely and arrive at actual flows to be expected. Only then can the adequacy of flow be determined to assure that proper stand-by pump temperature will be maintained

In designs where hydraulic balance is accomplished through the use of opposed impellers rather than a balancing device of some kind, this method of boiler feed pump warm-up is impossible since there is no external flow. In these designs, the small jumper line with the reducer is usually the only method available.

For any particular boiler feed pump arrangement, usually one of the above methods of ensuring stand-by pump warm-up will be found to be superior to the others by virtue of first cost, operating cost, or degree of reliability. The important point is that some method should always be provided to accomplish this necessary function because only then will stand-by boiler feed pumps fulfill their primary function, which is immediate, successful start-up when unexpected failure of operating equipment occurs.

Does Mixing Additives Ease Residual Fuel-Oil Burning?

MIXING OF ADDITIVES as a promising method for insuring the trouble-free burning of residual fuel oil was discussed by a Swiss engineer at the 1954 annual ASME meeting.

The speaker was P. T. Sulzer, of Sulzer Bros., Ltd., Winterthur, Switzerland.

Mr. Sulzer based his paper, which dealt with the formation of deposits from residual fuels, on studies and investigations conducted in Switzerland and on Swiss and American reports on the subject.

Exhaustive practical tests at the semi-closed cycle, 20,000-kw gas-turbine plant of the North East Swiss Power Co. were described by Mr. Sulzer. Residual fuels were burned with and without additives.

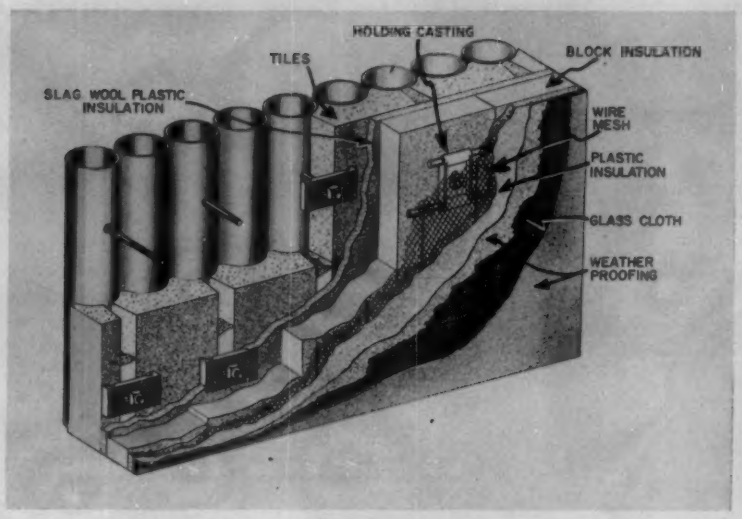
Said Mr. Sulzer: "Very favorable results were obtained by adding a suspension consisting mostly of aluminum silicates. The total running time, using treated fuels, was 2200 hours. During all this time it was not found necessary to clean the turbine."

Mr. Sulzer's talk included observations on oil ash deposits with fuels of high vanadium content, high alkali content, and high silicon content. He also gave details of the experimental techniques used and the arrangement of a test rig.

Mr. Sulzer's observations on ash-deposit formation as a function of temperature, pressure, excess air, fuel-ash content, and test duration were amplified by graphs and summarized in a formula.

In conclusion, Mr. Sulzer said: "It is believed that the observations enable some conclusions to be drawn about the interaction of various phenomena, as well as about the effect of the most important quantities in the formation of oil-ash deposits. The study of the rather complicated processes is not only of academic interest, but has given valuable assistance in the preparation of fuel additives."

Copies of Mr. Sulzer's paper, No. 54-A-171, can be obtained at 50 cents each from Order Dept., ASME, 29 W. 39th St., New York 18, N. Y.



Cut-away view of outdoor boiler casing construction showing how various sections of tile, wire mesh, insulation are installed outside tangential furnace wall tubes

This Outdoor Boiler Enclosure Uses Insulation Only

IN MANY SECTIONS of the United States, well-designed steel casings, when properly maintained, have long life. But in certain territories, such as along the seacoast, a steel casing is subject to attack by moist salt air. Similar problems, only worse, are encountered with waste-heat boilers in copper smelters. There, sulphurous air at temperatures below the dew point soon corrode any exposed metal. Sulphuric acid can also corrode the casing from the furnace side. When this occurs, the refractory wall enclosures no longer remain in their original position. Any air leak through the steel casing is at once reflected in fuel costs.

In December, 1949, POWER ENGINEERING printed an article on refractory enclosures behind water walls. Many installations of this construction are in service. To date, it is claimed that not a single stud bolt has overheated or burned out, nor has an alloy stud ever been used. To obtain best results the studs are of the same type of steel as the tubes.

Constructions described in that article are designed primarily for refractory enclosures back of spaced water walls on indoor boilers. That article also described the relative merits of (1) placing the tiles directly behind and against the tubes, (2) between the tubes, and (3) away from the tubes.

This article discusses refractory water wall backing behind tangential tubes, as well as waterproof enclosures for outdoor installation.

Behind tangential tubes, each refractory tile spans two or three tubes instead of being between pairs of tubes, as was the case in the previous article. In spanning two or three tubes, care must be taken in the design of the refractories so that the refractories only touch the tubes that anchor the tiles, otherwise any misalignment of the intermediate tubes or any vibration of the intermediate tube might tend to crack the tile.

Instead of using a rectangular tile directly behind the tubes, the method shown here fills the triangular space behind the tubes, in order to eliminate one of the major causes of gas pockets and the starting point of leakage through tiles and insulation.

Principles underlying the support of these latter tiles are the same as described in the previous article. Some of the stud bolts and castings anchor the tiles directly to the tubes, while other stud bolts are elongated to hold the insulation. The stud bolts do not burn out, it is claimed, because the "taper" at the side of the tiles forms a V slot. High-temperature plastic insulation is placed in the slot and around the stud, not only to protect the stud from overheating, but also to act as an air seal.

Outside of the tile wall is then covered with a high-temperature slag wool plastic insulation. Block insulation of the desired thickness is then cemented in place while the plastic insulation is still wet. In addition, this block insulation is held in position by rods. The holding rods in turn are secured to the elongated stud by means of a holding casting. This is designed to give a firm but flexible structure that permits the refractories and insulation to expand and move with the tiles.

Rib wire mesh is attached to the outside of the rods. The most serviceable mesh discovered to date is the Bar-X lath. An outside coat of plastic insulation is then troweled to the lath. Since the mesh is spaced away from the blocks by the thickness of the rods, the insulation is suitably keyed through the mesh, thus the outer finish is entirely independent of any vibration or movement of the refractories or block insulation.

After the finish insulation has been troweled and cured, two coats of weatherproofing are applied. Between the two coats of weatherproofing is placed a reinforcing of glass cloth. This glass cloth does not expand, nor does it shrink or stretch; therefore it is necessary to sectionalize the walls into sections not exceeding 6 ft by 6 ft in size. Care must be taken in forming the expansion joints between each section so as to avoid any possibility of air or moisture leakage.

Normally, modified commercial galvanized iron corner beads can be used as expansion joints. If atmosphere is corrosive, special expansion joints made of copper should be used.

The mastic covering, while resistant to salt and acid fumes, is designed to remain plastic for many years. The mastic will shrink when applied. In order to have $\frac{3}{8}$ in. final thickness after shrinkage, it is necessary for the two coats to have a total overall thickness of $\frac{3}{4}$ in. when applied.

Want More Information?

Write the Editor or jot BOILER WALL on return post card elsewhere in this issue and mail to us.

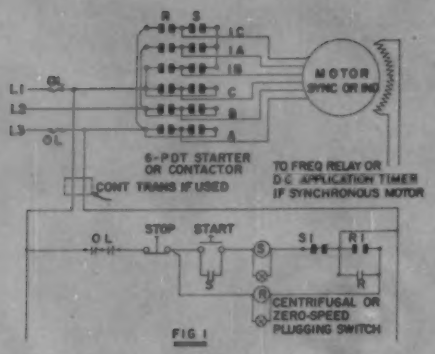


FIG 1

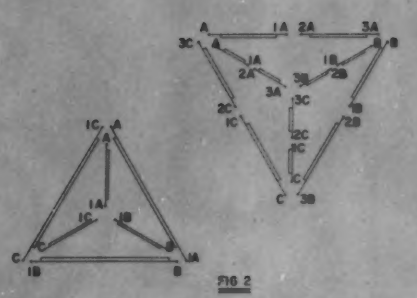


FIG 2

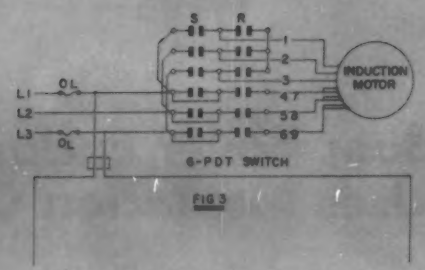


FIG 3

Fig. 1. Schematic diagram showing how standard polyphase motor starter can be adapted for reduced voltage starting

Fig. 2. Stator designations of single and dual-voltage motor windings for star connected starting and delta running

Fig. 3. Contactor connections for double-star dual-voltage motor; series start and parallel run. Same control as Fig. 1

An Emergency Motor Starter

Though not recommended for new or permanent installations, the author's ingenious adaptation of standard starters to give reduced voltage starting could prove invaluable in case of an emergency

By RALPH R. TAGGS, E.E.

THE WRITER HAS devised a method of motor control and acceleration that is trouble-free and certainly economical. Though not recommended for new or permanent installations, it serves exceedingly well under emergency conditions for motor drives of from 20 to 200 hp that cannot bear the expense of commercial reduced-voltage starting equipment.

Just for the record, it should be stated that the "star-delta" start and run method has been popular in Europe for many years and migrated to this country after the then unpopular a-c motor became a proven object of economy and simplicity.

Figure 1 illustrates a typical scheme of control applicable to most polyphase motors. Note the six-pole, double-throw switch, either air or oil break and magnetically-operated. The improvement here can be readily seen by studying the action of the centrifugal switch contacts "R1" and "S1." This action embodies a fully automatic transition from "start" to "run" condition regardless of the load, and has accurately controlled throw-over, or transfer, its movement being actuated by the predetermined speed of the motor as selected by governing the time-break operation of the centrifugal switch.

An old-style Westinghouse zero-speed (plugging) switch was revamped, provided with a S.P.D.T. toggle-action switch with a tripping range of from 20 to 90 per cent of motor full load speed. (4-pole, 1750 rpm.) This early (torpedo head) device was attached to the motor shaft, opposite to drive pulley, through a flexible shaft coupling and became an integral part of the motor end-bell. As this housing is only 5 in. by 8 in., it is inconspicuous on the larger motors.

The centrifugal unit is wired and connected to the motor terminal box with flexible-metallic conduit, thence to the multi-pole contactor. The sole inconvenience (at that time) of the entire circuit was the utilization of a "lock-out" stop button of the momentary-contact type. This was to insure that contactor coil "R" would remain de-energized during the decelerating period and before contact point "R1" was released. Though an operator requires only a few seconds to effect an "R1" release (below the 50 per cent speed range), it was deemed necessary, due to the human element, to introduce the former "stop" action.

Today, control stations may be obtained with the momentary-contact start button which, when pushed, releases, or recloses, the stop button contact through a latching mechanism — the stop button normally remaining open after each finger operation.

Several excellent six-pole, double-throw contactors and/or starters (with the auxiliary contacts) are obtainable from leading electrical manufacturers.

Figure 2 shows stator connections for single and two-voltage windings. The dual-voltage stator winding indicated on the right gives several motor-accelerating opportunities.

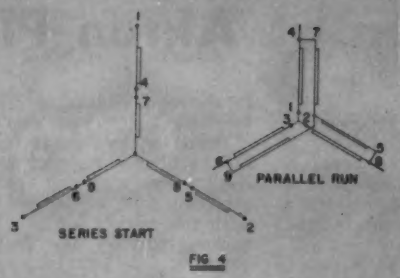


FIG 4

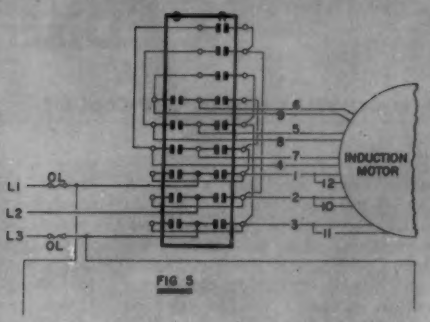


FIG 5

Fig. 4. Stator designation of commonly used two-star dual-voltage motor having nine external leads at terminal block

Fig. 5. Contactor wiring for delta-series start and delta-parallel run. Note extra contact points. Control as Fig. 1

Fig. 6. Stator designations for control arrangement shown in Fig. 5 for delta-series start and delta parallel run

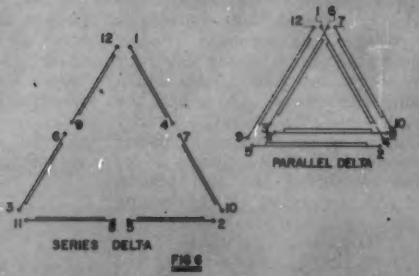


FIG 6

— That Works

Right: Stator interconnection data. Letter designations shown in Figs. 1 to 6

Figure 3 is the contactor wiring diagram as it would appear connected to a star-connected, parallel-wound stator of the popular nine-lead variety, Fig. 4. This same operational sequence can be derived from the dual-voltage, double-delta, 12-lead machine, but with an obviously different lead wiring method at the starter. See Fig. 5 and Fig. 6.

The table of stator connections is only a portion of the possibilities available in our currently involved motor drives. A few minor revisions of the circuiting will provide the reader with ideas concerning the acceleration of direct current motors with either two or more steps in the resistance increments. The lead designations shown on the chart are as standard with A.S.A., J.I.C., and the A.I.E.E.

Synchronous motors and rotary converters are handled similarly — their stator windings being identical with those of the various induction motors. Auxiliary control devices are easily incorporated into new or improvised installations.

Type Winding	Start Connection	Per cent Current:	Per cent Voltage:	Run Connection	Per cent Current:
Single Delta	Line: A-B-C Tie: 1A-1B-1C	57.7	57.7	Line: A-1C B-1A C-1B	173.2
Double Delta "Star Start"	Line: A-3C B-3A C-3B Tie: 1A-2A, 1B-2B 1C-2C	50.0	50.0	Line: A-2A-1C-3C B-2B-1A-3A C-2C-1B-3B	100.0
Double Star Delta	Line: A-B-C Tie: 3A-3B-3C Permanent Connections: 1A-2A, 1B-2B 1C-2C	57.7	57.7	Line: A-3C B-3A C-3B	173.2
Dual-Voltage Double-Star	Line: 1–2–3 Tie: 4–7 5–8 6–9	50.0	50.0	Line: 4–7 5–8 6–9	100.0
Synchronous Motor Windings	Above Scheme Applicable				
Induction-Repulsion 5 to 20 hp	Line: 1 & 4 Tie: 2 & 3 Single-Phase Series	50.0	50.0	Line: 1 & 3 2 & 4 Single-Phase Parallel	100.0
Double Delta "Parallel Run"	Line: 1–12, 2–10, 3–11 Tie: 4–7, 5–8 6–9	50.0	50.0	Line: 1–6–7–12; 2–4–8–10; 3–5–9–11	100.0

Goodyear Modernizes Electrical Power Distribution at Akron Plant

By J. McDOWELL* and G. J. DICAUDO*

ELECTRICAL FACILITIES which serve the Akron plants of The Goodyear Tire & Rubber Company have undergone a major modernization. The electrical demand of these plants reaches 55,000 kw, and until recently, Goodyear generation supplied 90 per cent of this and Ohio Edison Company the balance, as well as a standby service.

Back in 1916 when the Akron plants experienced spectacular growth, the present 2300-v distribution voltage was adopted. Power was generated in two Goodyear power plants about one mile apart, which also supplied process steam and the other power services for the nearby manufacturing areas. Edison power was received at 23 kv, and a 23-kv tie line connected the two plants. Power was generated by condensing turbines, supplemented later by topping units.

The switching scheme adopted was flexible and the switchhouses equipped according to the best standards of the time. Double bus systems were provided for the 23-kv and 2.3-kv services and housed in concrete cell structures. All oil circuit breakers were placed in masonry cells. The step-down transformers were of the water-cooled type. A radial system of distribution was used from the power stations to a system of load center substations. (See diagram, Fig. 6a.)

Through the years that followed, the short-circuit current of the system rose steadily to values in excess of 100,000 amperes on the 2300-v system. During the same period, switchgear manufacturers drastically reduced the interrupting capacity ratings of our circuit breakers. To meet these conditions, we resorted to the use of lock-out relays on the feeder breakers and placed the interrupting duty on the more highly rated back-up breakers. This reduced the risk but also destroyed the quality of the service. A fault on even a minor feeder would shut down an important section of the main plant.

Three years ago a combination of circumstances made possible a major rehabilitation of the switching scheme:

a. We were confronted with a smoke and fly ash abatement problem of major proportions, as it involved a large number of our low pressure boilers of old vintage.

b. An analysis of our power plant operations showed that we were using enough process steam to generate additional low-cost electrical energy from a topping unit.

c. The substitution of two high-pressure boilers, equipped with the latest combustion control and dust collecting devices, for a number of the old boilers, could provide the required steam for the new turbine and would solve the smoke and fly ash abatement problem.

d. The increase in generating capacity, of course, would intensify the short-circuit capacity of our electrical system. However, the savings effected by the increased efficiency of our generating plant would also pay for the rehabilitation of our switching facilities which was also desirable.

Based on this study, carried out by the firm of Sargent & Lundy in conjunction with the Goodyear engineering staff, we decided to proceed with the installation of a 12,500-kw topping turbine (see POWER ENGINEERING, July 1954 issue) and a complete modernization of our switching facilities. This project has recently been completed.

The present article confines itself to a review of the new switching facilities only. (See Fig. 6b.)

The 23-kv bus serves as main bus and synchronizing bus. All circuit breakers connected to this bus have a minimum interrupting capacity of 1000 mva.

A double circuit 23-kv tie line connects the two main switching stations. Each circuit has a capacity of 20,000 kva and only the capacity of one circuit is needed at any one time.

Large blocks of power are served by 23-kv feeders radiating from the 23-kv busses at each plant. One important manufacturing division is thus served through a new 15,000-kva packaged type outdoor substation, subject to supervisory control from the power house. The 2.3 kv sub feeders radiate from there. (See Fig. 1.)

Edison power can also be received at 23 kv and made available at either plant. If such power is used we operate in parallel with the power company and effective relaying has been provided for the protection of Goodyear and the power company under fault conditions.

The 2300-v distribution system is still being used to supply our larger motors, which range in size to 1500 hp. However, the system is now decentralized, consisting of a number of isolated systems, each one served by a 7500-kva step-down transformer.

* Electrical Engineering Staff, The Goodyear Tire & Rubber Co.

Fig. 1. (*Left*) New 15,000-kva packaged type outdoor substation which is controlled from power house; Fig. 2, (*right*), shows sectionalized 2300-v switchgear

Table of new electrical equipment

PLANT 1

- 23-kv main circuit breakers. General Electric type FH-126, low oil content, 1200-amp, 1000-mva
- 2300-v main feeder circuit breakers. Allis-Chalmers, all metal clad, vertical lift, air break, 1200-amp, 150-mva
- 2300-v breakers for PH auxiliaries. Westinghouse, all metal clad, horizontal drawout, air break, 1200 amp, 50 mva
- 7500-kva step-up transformer. Allis-Chalmers, 24,000/2400-v, 3-phase, 60-cycle, oil filled
- 2300-v Allis-Chalmers busduct for transformer secondaries rated 2500-v, 2500-amp
- 440-v metal clad switchboard. I-T-E, 2000- and 1600-amp air circuit breakers

PLANT 2

- 23-kv main circuit breakers. Brown Boveri, air blast, 1000-amp, 1000-mva
- 2300-v main feeder circuit breakers. Allis-Chalmers, metal clad, vertical lift, air break, 1200-amp, 150-mva
- 15,000-kva primary outdoor substation, consisting of three 5000-kva, 24,000/2400, 31,000 transformers, primary oil switches, 2300-v circuit breakers, metal clad, horizontal drawout, air break, 1200-amp, 150-mva, Westinghouse
- Transformer and generator metal enclosed busduct. I-T-E, 4160-v, 3000-amp
- 2300-v lighting bus circuit breakers. I-T-E, metal clad, horizontal drawout, air break, 1200-amp, 50-mva
- Supervisory control and telemetering for control of primary substation. Control Corp.
- Multi-conductor power and control cable by General Electric and Okonite

All circuit breakers connected to the 2300-v busses have an interrupting capacity of 150 mva and are capable of handling any fault current possible on that system. See Fig. 2. All 2.3-kv systems are protected by grounding transformers.

In planning the new layout we dispensed with the double bus system to save space and money. We believe that the quality of the installations and insulation levels, backed up by dependable circuit breakers and effective relay protection, justify our dependence on a single bus.

To reduce the hazard of oil fires to a minimum, all new 2300-v switchgear is of the air break type. The 23-kv switchgear at Plant 1 is of the compressed air type, pneumatically operated. See Figs. 3 and 4. At Plant 2 the most economical solution was accomplished by the use of low oil content breakers which could be readily substituted for old breakers of the same type. All switchgear and bus compartments are metal clad and of pleasing design.

All 2300-v feeder cables and all control cables used have VC insulation and are protected by a vinyl

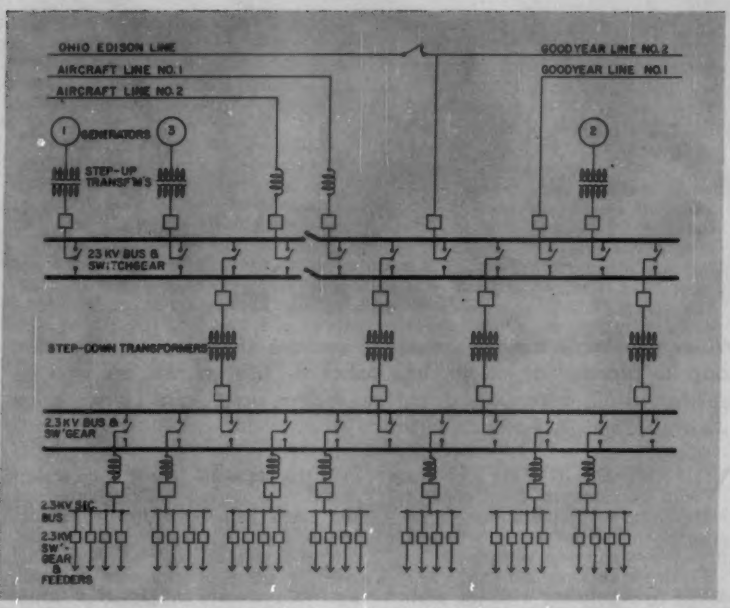


Fig. 6a. Simplified wiring diagram shows old switching scheme at Goodyear plant

Fig. 3. (*Left*) Sectionalized 2300-v, 23-kv switchgear at Plant 1 is pneumatically-operated, compressed-air type with air break. Fig. 4. (*Center*) Air-operated breakers. Fig. 5. (*Right*) Cables with interlocking armor supported by cable ladders

jacket and interlocking armor. They are routed overhead and supported on cable ladders (Fig. 5), a method of construction that we have found efficient and reliable. Cable failures are practically unknown at Goodyear. Approximately 200,000 feet of multi-conductor power and control cable were used in this project.

Careful planning was needed in the execution of the project, as it involved an almost complete replacement of every piece of switchgear and bus that form the heart of our distribution system. The work was carried out without interruption of manufacturing operations. The adoption of an 800-amp capacity feeder as standard for 2300-v distribution, in place of the 400-amp capacity feeder previously used, reduced the number of breaker units and provided the space needed for the placement of the first new unit. The adoption of 23-kv distribution to important load centers removed additional 2300-v equipment from the power house. From then on it was a matter of step-by-step progress until the job was done.

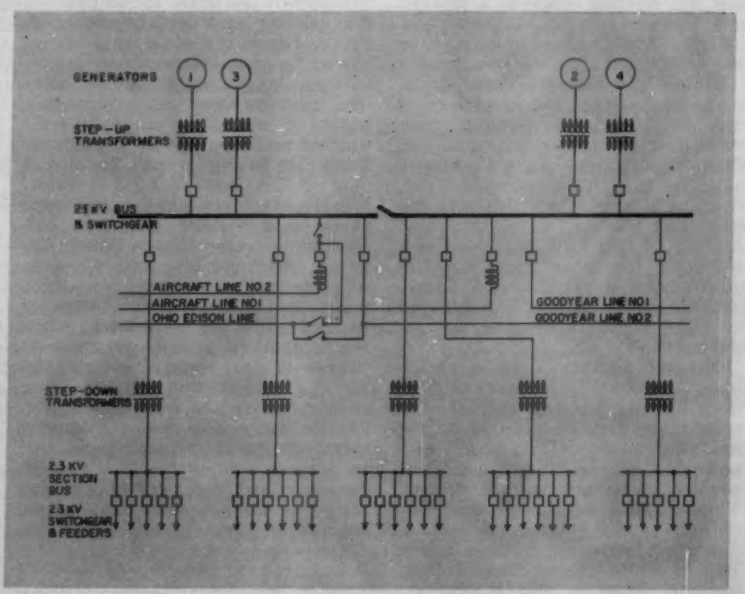
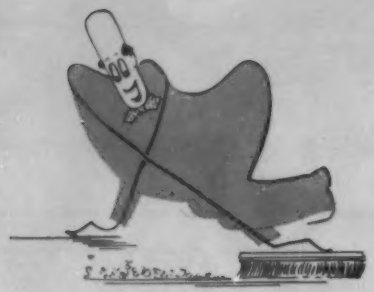


Fig. 6b. New switching scheme adopted in modernization of electrical facilities



Clean That Concrete!

When you know how, it's easy to remove stains caused by iron, copper, bronze, aluminum, ink, tobacco, fire, smoke, as well as lubricating oil, rotten wood, coffee, iodine, urine, and perspiration

NEARLY EVERY kind of stain can be removed from concrete, though long-neglected stains may require repeating the treatment several times before the stain disappears.

Surface stains can generally be removed by scrubbing with the proper chemical. Stains which have penetrated deeply usually require a poultice or bandage. A poultice is made by mixing active chemicals with a fine inert powder to a pasty consistency and this is applied in a thick layer. Bandages consist of cotton batting, or layers of cloth, soaked in chemicals and pasted over the stain.

The correct application for each stain is given below. Care should be exercised when using acids or chemicals, for even weak acids may roughen the surface if left in contact for any length of time.

Aluminum: Aluminum stains appear as a white deposit which can be removed by scrubbing with a 10 to 20 per cent solution of muriatic acid. On colored concrete, a weaker acid solution should be used. The concrete should be flushed with water just before and after the treatment.

Bronze and Copper: These stains are generally green, but in some cases may be brown. To remove these stains mix 1 part of dry ammonium chloride (sal ammoniac) with 4 parts powdered talc. Stir in ammonia water to make a paste. Place this over the stain and leave it there until dry. A stain of this kind that has been collecting for some years may require several applications to remove it. Aluminum chloride may be used in place of sal ammoniac in this treatment.

Fire and Smoke: Concrete is often badly discolored from smoke or pitch from burning wood. Sometimes the appearance may be restored by the following process. First scour with powdered pumice or grit scrubbing powder to remove surface deposit. Then make a solution of trisodium phosphate and chlorinated lime, as described below for tobacco stains. Fold a white canton flannel cloth, forming three or four layers, and saturate with the liquid. Paste this over the stain and cover with a slab of concrete or glass, making sure that the cloth is pressed firmly against the surface. If on a vertical plane, devise a method to hold the flannel and its glass or concrete covering against the stain snugly. Resaturate the cloth as often as necessary. Deep pitch stains especially will need several treatments.

Ink: Ordinary writing inks may etch concrete due to their acid content. To remove an ink stain, make a strong solution of sodium perborate in hot water, mix with whiting to a thick paste, apply a ½ in. layer, and leave in place until dry. If some of the blue color is visible after the poultice is removed, repeat the operation. If only a brown stain remains, treat it by the method described for rust.

Many red, green, violet and other bright colored inks are water solutions of synthetic dyes. Stains made by this type of ink can usually be removed by use of the sodium perborate solution and poultice described above. Often the stain can be removed by ammonia water on cotton batting. Javelle water is also effective, used the same way as ammonia water or mixed to a paste with whiting and applied as a poultice. To make Javelle water, dissolve 3 lb of washing soda in 1 gal of water. Mix 12 oz of chlorinated lime to a paste in a shallow enameled pan by adding water slowly. Mash the lumps. Add the paste to the soda solution, make up to 2 gal by adding water, and place in a stoneware jar to settle. Use the clear liquid when required, diluting with six times its volume of clear water. Use as a soap or other scrubbing solution, first rinsing the surface with clear water. Javelle water is a strong bleaching solution, and should not be allowed to drop on colored fabrics. It is not recommended for general cleaning purposes, but its occasional use on stained concrete is believed to be entirely safe.

Lubricating Oil: Saturate white canton flannel in a mixture of equal parts of acetone and amyl acetate, and place it over the stain. Cover the saturated cloth with another slab of concrete to hold it in place. (Covering the saturated cloth with glass or any other non-porous type of slab tends to drive the stain further into the concrete, while covering it with another piece of concrete tends to draw the stain out of the concrete being cleaned and into the concrete being used as a cover.) Keep the saturated cloth in place until the stain has gone. Scrubbing with gasoline or benzine will often remove oil stains.

Lubricating oil penetrates some concrete readily, and whenever possible it should be mopped off immediately, covering the spot with Fuller's earth or dry powdered material such as hydrated lime, whiting or dry portland cement. If treated soon enough, there will be no stain. However, if the oil has remained for some time, the method described above should be used.

Iron: Method 1. Dissolve 1 part sodium citrate in 6 parts water. Mix thoroughly with an equal volume of glycerin. Mix part of this liquid with whiting to form a thick paste stiff enough to adhere to the surface in a thick coat. Apply the mixture with a putty knife or trowel. It will dry in a few days, and it should then be replaced with a new layer or softened by addition of the sodium citrate and glycerin solution. This treatment has no ill effects, but it may be too slow for some cases. Ammonium citrate may be substituted for the sodium citrate in the solution to produce a quicker reaction, but this may injure polished surfaces slightly.

Method 2. For deep iron stains, sodium hyposulphite ($Na_2S_2O_4$). The surface should first be soaked with a solution made by dissolving 1 part of sodium citrate crystals in 6 parts water. Dip a white cloth or cotton batting in this solution and paste over the stains for 10 or 15 minutes. On horizontal surfaces, sprinkle over with a thin layer of hydrosuiphite crystals, moisten with water, and cover with a stiff paste of whiting and water. On a vertical surface,

place whiting paste on a plasterer's trowel, sprinkle on a layer of hydrosulphite crystals, moisten slightly, and apply to the stain. Remove in 1 hr in either case. Do not leave longer, or a black stain may develop. If the iron stain is not removed, repeat the operation with fresh materials. When the stain disappears, rinse the surface thoroughly with plain water.

Large areas of concrete slightly stained with iron may be cleared by using a solution of 1 lb of oxalic acid per gal of water. The solution should be mopped on and left standing for 2 or 3 hr. Then rinse the surface with clear water, at the same time scrubbing with stiff brushes or brooms. Bad spots may require a second treatment.

Rotten Wood: When damp, wood will often rot and cause a chocolate colored stain which is usually much darker than other stains. The best treatment is the one described above for removing fire stains. Action may be accelerated by first scrubbing the surface thoroughly with glycerin diluted with four times its volume of water.

General Discoloration: Where areas of terrazzo flooring become yellow while adjacent slabs remain free from discoloration, the trouble is probably due to the original finishing of the floor. Such discoloration can usually be cured by a surface scrubbing with Javelle water. Directions for making Javelle water are given above in the section on ink stains.

Tobacco: Dissolve 2 lb of trisodium phosphate crystals in 1 gal hot water. Make a paste of 12 oz of chlorinated lime by adding water slowly and mashing in a shallow enameled pan. Pour this and the trisodium phosphate solution into a 2 gal stoneware jar and add more water until full. Stir well, cover the jar, and allow the lime to settle. To use, add some of the liquid to powdered talc until a thick paste is obtained. Apply with a trowel as a ½ in. poultice. To apply with a brush, add about one teaspoon of sugar to each pound of powdered talc. When dry, scrape this off with a wooden paddle or trowel. This mixture is a strong bleaching agent, and is corrosive to metals. Care should be taken not to drop it on colored fabrics or metal fixtures.

This method can also be used for treating other stains. Trisodium phosphate may be purchased at chemical supply or laundry supply houses.

If the stain is not bad, grit scrubbing powders commonly used on marble, terrazzo and tile floors are often satisfactory as a poulticing material. Stir powder into hot water until mortar consistency is obtained. Mix thoroughly, then apply to stained surface in a ½ in. layer. Leave poultice in place till dry. In most instances, two or more applications will be necessary.

Urine Stains: Use method outlined for tobacco stains. Should the stain prove stubborn, saturate cotton batting in the liquids and paste over remaining stain. Resaturate the cotton if necessary.

Coffee Stains: Coffee stains can be removed by applying a cloth saturated in glycerin diluted with four times its volume of water. Javelle water, or the solution used on fire stains, is also effective.

Iodine Stains: An iodine stain will gradually disappear of its own accord. It may be removed quickly by applying alcohol and covering with whiting or talcum powder. If on a vertical wall, mix talcum to a paste with alcohol, apply some alcohol to the stain, then cover with the paste.

Perspiration Stains: Secretions from the hands or oil from the hair may produce stains on concrete. The stain is brown or yellow and may be mistaken for an iron stain. The best treatment is that recommended for fire stains. Bad stains may require several treatments.

High Pressure Feed Water Treatment

DURING the past 25 years, boiler pressures have increased from approximately 1200 to a high of 5000 psi in plants designed exclusively for the manufacture of electric power and from 600 to 2400 psi in by-product power plants requiring 100 per cent makeup. Prior to a few years ago, this makeup was either softened or evaporated in an endeavor to hold mineral solids in the boiler water to a minimum.

Demineralization has substantially replaced various methods of water softening for high pressures in recent years. The process is equally suitable for treatment of a small percentage makeup for surface condensing plants and for by-product power plants utilizing 100 per cent makeup. These facts were stressed in a paper presented before the Missouri Valley Electric Association Engineers Conference in Kansas City, Mo., on March 23 by Joseph D. Yoder, vice president, The Permutit Co.

In his address Feed Water Treatment for Modern High Pressure Boilers he stated, "Increased boiler pressure, steam temperature, and steam reheating have been chiefly responsible for increased thermal efficiencies in generating electrical energy. Demineralization by ion exchange has performed an important function in producing suitable conditions for these requirements."

The author, in his paper, brings forth the principles and historical development of the demineralizing process. Several types of such equipment with their respective advantages and limitations were described. Also, the requirements of water treatment for supercritical pressures and nuclear power reactors were described.

Creep of Delray's 900-F Pipe Checks Predictions

ANALYSIS of the rates of creep observed in two carbon-molybdenum steel steam pipes after 100,000 hours of service at 900 F has resulted in a figure of 0.002 per cent per 1000 hours or less under operating stress of 7500 psi. This is in agreement with predictions of laboratory creep data, it was reported at the annual meeting of ASME.

This unusual proof that short-time laboratory creep tests truly simulate service conditions was presented as a paper by four authors: R. J. Sinnott, The Detroit Edison Co., I. A. Rohrig, J. W. Freeman, and A. I. Rush, all of the University of Michigan's Engineering Research Institute, Detroit.

Analysis of the service conditions indicated that 100,000 hours of service at 900 F under 7500 psi would have been expected to use up only a negligible amount of the available creep-rupture life of the steel. All laboratory test results support this conclusion. Deterioration of creep strength from structural changes, such as spheroidization, was certainly no greater than might have been expected.

The creep-measurement program was initiated in 1938 when Unit No. 14 was installed at the Delray Power Plant of The Detroit Edison Co. At that time stainless steel-measuring points were arc-welded on the external surfaces of two 10-in. nominal diameter pipes connecting the turbine emergency stop valve to the upper and lower steam chests of the turbine. These buttons were located so as to provide both diametral and axial measuring stations.

Measurements were made after five intervals of time: in 1940, 1942, 1944, 1947, and finally in 1951.

Although differences in creep rates were observed during the five periods, little significance could be placed on this fact.

Copies of the paper, entitled Carbon-Molybdenum Steel Steam Pipe After 100,000 Hours of Service may be obtained at 50 cents each from Order Dept. ASME, 29 W. 39th St., New York 18, N. Y.

Your Coal Performance Records Can Help Your Coal Supplier Help You

Case history records of coal performance in your plant can be of great value to your coal suppliers' representatives if made readily available for quick, easy perusal. More important, they enable coal suppliers to give you better, trouble-free service all down the line

By **FRED M. REITER***

COAL SALES representatives can tell some interesting stories about habits and policies of coal buyers. Some coal buyers keep their records a deep secret from everybody, frequently from those inside as well as outside their company. Many tell coal supplier representatives little about the results obtained from the coal received from them. Perhaps a very few go to the other extreme of telling more than is needed; codes of ethics require the maintenance of confidential relationships.

But the supplier representative, or salesman, as we shall call him, should know all the details of his coal service — from the mine face to the ash dump of the consumer.

The salesman, of course, must assume the responsibility for the supplier that he represents, although he may not be located in the office that handles shipments, records, or the orders themselves. He may not see the analyses or delivery rates. He is just as anxious to learn what happens as is the buyer. The salesman is the front-line skirmisher; part of his job is to help the buyer get what he ordered, and he is therefore entitled to full knowledge of the use history of his product. He should get this information on his regular monthly or periodic visits, rather than by telephone or telegraphic means. These should be reserved for emergencies. Between visits, letters are a desirable means of exchanging information.

Full Story Provided

The Dayton Power and Light Company has undertaken to present every coal representative with his full story. The salesman can lose his brief case on visits to this company. His file folder in our office is his to study, copy any data, ask questions, discuss records, ask for help, offer his services. All of this, to which he has fullest access, can come out of our records on his coal.

This is accomplished by making up a complete folder for each supplier separately, and for each station where his coal is used. The different stations require their own type of coal, under their specifications. These stations are denoted by the color of the tabs on green outer binder of each folder.

Each tab bears the name of the coal supplying company to whom the purchase order is sent. If the firm has supplied several different coals from different mines to the same station, these mine sources are all contained in this single folder. The heavy green outer binder contains two cardboard separators, so that six surfaces are available within the folder on which to carry the different data it is desired to accumulate. Figure 1 shows the general arrangement of the folder. Each surface, or *face* as it is referred to hereafter, has attached to it successive monthly data of its specific function. These data sheets are accumulated for twelve months, the oldest being discarded as a new sheet is added. These six faces are described as follows:

1. Face 1 is a form sheet on which is tabulated the monthly shipping schedules and receiving data on tons, cars or trucks, daily and cumulative, for the current month. Figure 4 shows this sheet and its columns.

Column 1 has a printed tabulation of the days of the current month, 1 to 31. All entries on this sheet are tied to this column of dates as our operating base. We have recently set up a fiscal month which starts our tabulations five days before the beginning of the month. This will be described later.

2. Under the first group of columns marked SCHEDULED are recorded the breakdown of the complete purchase order in terms of what is supposed to be shipped each day, in tons of coal, number of cars or trucks, and the cumulative total of cars or trucks to date. The later actual events are tied to these regularly specified daily quantities throughout the given month. By the end of the month, the totals should correspond to those specified in the purchase order, which has been recorded at the top of the sheet as the TOTAL ALLOTMENT. The daily schedule entries will conform to the RATE PER DAY determined at the top of the page. Note the example sheet of Fig. 4.

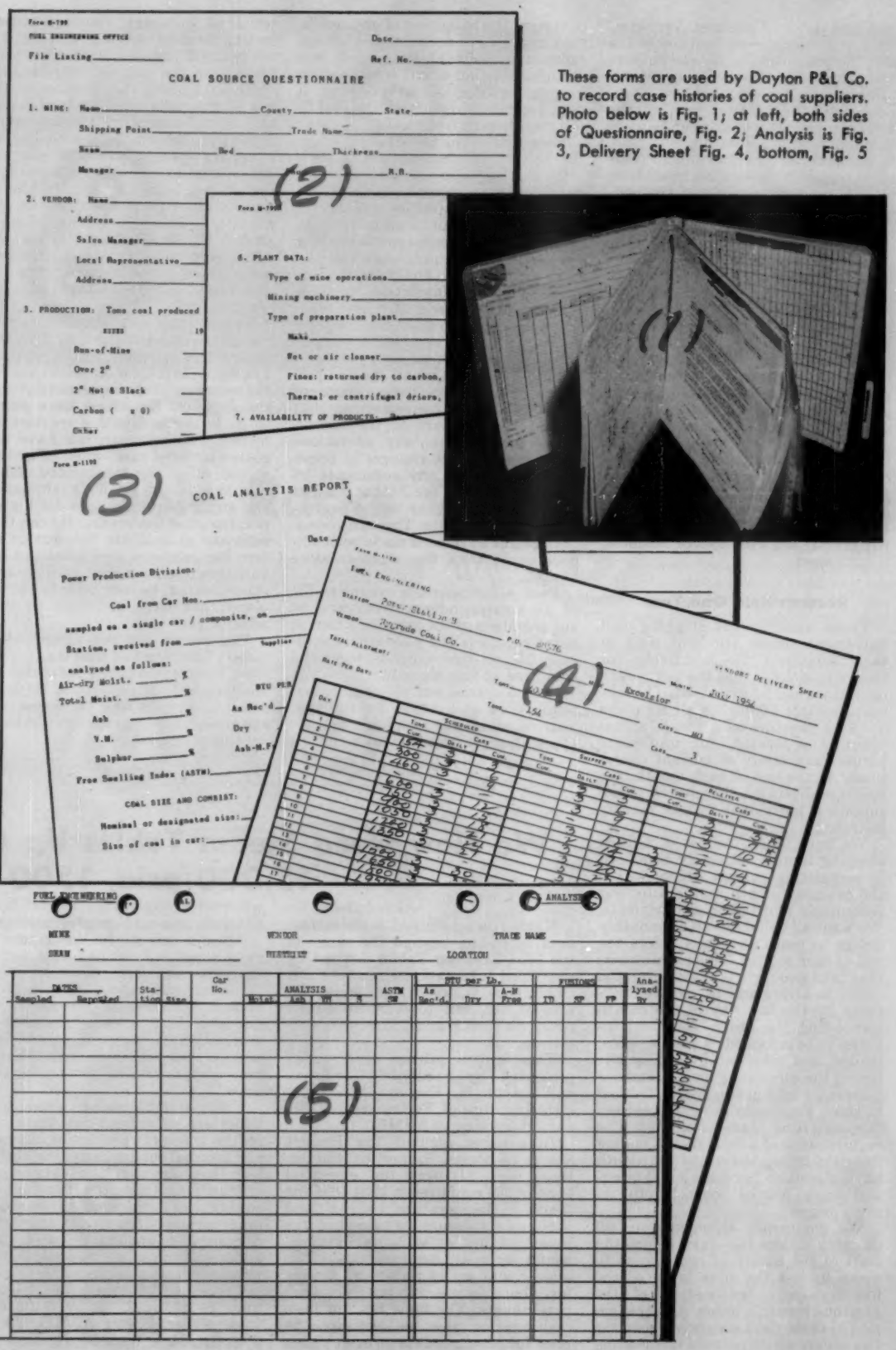
3. The second set of three columns entitled SHIPPED, records the actual tons, and the number of cars or trucks leaving the mine or dock each day, as these are listed on the shipping notices mailed to us daily by the supplier. The daily cumulative total of these shipments is also recorded in its column. These entries should be duplicates of the figures recorded under the corresponding SCHEDULED columns. We can tell at a glance each or any day whether this or any supplier has over- or under-shipped. We can warn him of his deviations. By studying these sheets of his own company, the salesman can visualize the shipping characteristics of his source and can take steps to remedy any errors. Or, he can point out to us the dependability of his firm insofar as the punctual regularity of their deliveries is concerned, if such be the case. We do not record the tonnages in this set of columns.

4. The third and last group of columns records actual receipts at our plant as phoned to our office when the cars are pulled into our siding, or after the trucks have delivered their coal to our pits. The phone call is followed up by the actual tally sheets of cars or trucks, giving car or truck numbers for checking against shipping notices and freight bills received shortly thereafter. In the first column of this last set, we re-enter the daily actual shipping figures of the first column of the second section under SHIPPED, but move the figures five days ahead to simulate the expected days of deliveries from the mines, where rail cars are involved.

Trucks No Problem

Trucks arrive on the day they start from the river docks, so that no delay is involved. Actual receipts, daily and cumulative, are entered in the last two columns, respectively. The purpose of these entries is to show the character of the rail service, delays in transit, bunching, and so on, so that we can place the blame for irregular deliveries where it belongs. We can watch for the causes for demurrage debit accumulations, with their resulting problems. These figures represent the flow of coal through our delivery pipe line — rail transit. Since we have no reciprocal switching, we cannot alter routing to help individual sources. These figures certainly point out to the salesman where faults lie and enable him to contact his traffic manager at his home office or at the mine for assistance in deliveries. We might call this the "logistics" of our supply. It requires constant vigilance. Any changes in schedules, no matter how made, by phone, wire, or letter, are confirmed in short form memoranda to all concerned. One copy is stapled to this Vendors Delivery Sheet for a record of the authoriza-

* **Fuel Engineer, The Dayton Power and Light Company.**



These forms are used by Dayton P&L Co. to record case histories of coal suppliers. Photo below is Fig. 1; at left, both sides of Questionnaire, Fig. 2; Analysis is Fig. 3, Delivery Sheet Fig. 4, bottom, Fig. 5

tion and dates of changes. Verbal or unrecorded orders can foul the works and the responsibility for the smooth operation of the flow of coal. Maintaining a constant flow of coal is undoubtedly the greatest part of the procurement program. It can be very complex, and exasperating.

We are now in a position to trace all movements, from mine to station, as well as deviations from the purchase order schedule caused by the tipple shipper, by the railroads, or by other means of transportation. The sample sheet shown as Fig. 4 illustrates the record of one supplier during a random month. It portrays to the salesman as well as to ourselves or to the reader of this article, the whole story of the delivery of his coal on our order. The salesman is entitled to view this record as a matter of personal satisfaction to him and to his company for regular shipments, or he may become concerned with delays or bunching in transit or any irregularity that may occur from any cause, under or beyond his control. He may be unaware of situations not deemed worthy of complaint by us to his source, but which could lead to irritations, and even loss of business, if continued.

Records Held One Year

These monthly car shipping and movement sheets are kept filed in each supplier's file additively for twelve months so that the past year's operations can be examined. The current month's sheets for all suppliers are kept together as a group, alphabetically separated, for immediate perusal and study of current operations. At the end of each month, the separate sheets are transferred to the suppliers' individual folders here illustrated.

We have found the use of a fiscal shipping month extremely beneficial in completing current orders within the calendar month required for our accounting and billing departments. We want all deliveries on all monthly orders to cease five days before the end of each month. This permits cars that take five days to travel from the mines to arrive and be received officially by the last day of the month completing the order. It allows invoices to be compiled on scale weights, mailed and received by us by the first of the succeeding month, and our records for billing, etc., can be finished in time. Payments are made earlier. Suspense records are eliminated. The requirements of a fiscal month ending five days before the end of the month have placed no hardship on shippers and have proved very helpful in every respect.

We commence shipments on all monthly orders two days before the start of the month of order so as to make up for the time lapse of the five-days-early termination of the previous month's order. A blank period of three days occurs between the two orders which permits the clearing of tracks, the balancing of any debits that might have accumulated on our railroad average agreement, or the straightening out of any irregularities in our logistical situation. Such a period comes in handy at the end of the month very frequently.

Face 2 holds the file of source questionnaires from this supplier on each mine that supplies this station. Since Fig. 2 illustrates the two sides of this questionnaire, no further comment is necessary. The comprehensive data contained in these questionnaires, particularly the properties of the coal, mining data, and company organization, are important to coal representatives, especially new men. The folder puts to good use the time consumed by the supplier in compiling the questionnaire.

Face 3 supplies blank sheets upon which are written notes made of direct or 'phone conversations that should become part of the record. These notes tell of any alterations made in schedules, changes in prices or conditions, or any comments on qualtity, costs, etc., that might otherwise be lost as verbal agreements or statements. These conversations might have been made with officials other than the representative himself.

Face 4 contains the complete file of all correspondence from and to any members of the supplier's firm or ourselves. It is the only correspondence file on this supplier regarding coal used at this station.

Face 5 carries our file of purchase requisitions and orders for the past year on all of this supplier's coal for this station. It gives the salesman the terms of shipment, routing, prices, instructions on sending of shipping notices and invoices, and other conditions of the original transaction.

Face 6 gathers the chemical qualities of the coals supplied to this station by this supplier. All laboratory reports are accumulated with a cover summary sheet on which all analyses are entered for a quick historical record of each separate coal. Variations and trends can be detected in the summary sheet. This is a valuable section to the salesman. He has the privilege of copying the figures and using them as he desires. Figure 3 illustrates our laboratory analysis report; Fig. 5, the summary form.

This six-face folder has become the complete record of the coal performance of this supplier, isolated in itself as a separate file, for ourselves and for the reference of the representatives of the supplier. No others have access to it. It is considered a confidential record. The salesman can have forgotten his brief case; when he arrives at our office the receptionist hands him this folder for his examination and study before the time for his appointment or conference. He can thus estimate or evaluate the service his firm has rendered and point out advantages that he might not have seen otherwise; or, he may offer to correct items that have not been to their advantage.

The reason for this article arises largely from the fact that many salesmen have commented favorably on the value of the folder and its information, and on the frankness and openness of the relationship created by this program.

We Now Need Steam Tables Up to 15,000 psia, 1500 F

NEED FOR additional experimental data extending beyond the range of the 1934 Skeleton Tables devised by the Third International Steam Table Conference is urgent, not alone for present use, but for turbine design suited to 1500 F and 15,000 psia conditions.

This is the subject of a paper presented by Frederick G. Keyes and Joseph H. Keenan, Massachusetts Institute of Technology, at the annual meeting of ASME.

In a paper entitled The Present Status of Steam Properties, the authors say, "It was the cherished hope of the conferees in 1934 that the limits of temperature 1032 F and 5000 psia pressure, attained in the investigation of water substance, would serve all requirements in the science and art of power production for the lifetime of the youngest participants. The hope has not been realized, for now we envisage the need for accurate data at even higher temperatures and greater pressures.

"Nor is this all, for we require far more exact and verified data for the viscosity and thermal conductivity of water substance than exist at present. Finally, it is now highly desirable that a comprehensive investigation be pursued on the relation of the international scale of temperature to the thermodynamic scale."

Citing and discussing valuable contributions to present-day knowledge on the transport properties, viscosity and thermal conductivity, the authors feel that many of the data require verification; thus, the two-fold desirability of devising an international organization to carry out a program of verifying present reported data, and researching into the higher temperatures and pressures.

Copies of the paper, No.54-A-237, may be obtained at 50 cents each from Order Dept., ASME, 29 W. 39th St., New York 18, N. Y.

Fig. 1. Shows contrast between conduit runs and cable racks. Cable racks cost less, weigh less, are easier to install

Fig. 2. Trays can be cut easily to make curved runs as shown. Background pile shows trays as they come in 8 ft lengths

Cable Racks Cut Wiring Costs

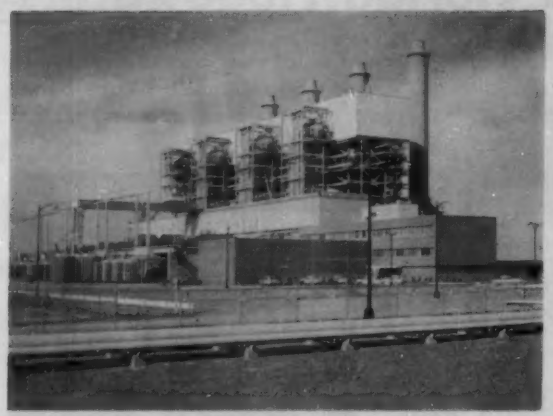


Fig. 3. New P.G. & E. plant at Pittsburg, Calif., in which cable racks described here carry control and instrument wiring

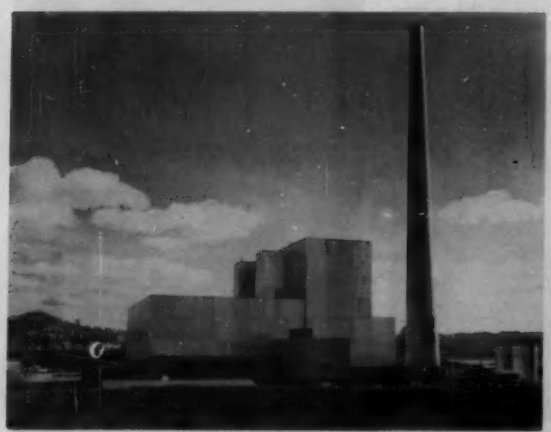


Fig. 4. P.G. & E.'s Morro Bay Station, Calif., where conduit costs have been drastically reduced by using cable trays

WHEN P.G. & E.'s giant Contra Costa Station at Antioch was built, conventional metal conduit was used for control, instrumentation, and annunciation. For the first three generators, totalling 575,000 kw, more than 360,000 ft of conduit was installed.

The expense and difficulties of installing so much conduit, particularly in the congested areas of the plant, provided a strong incentive to try out a better system in the future, and as a result, when Bechtel Corp. and P.G. & E. engineers got together to plan the electrical system for two additional units at Contra Costa, they decided to eliminate most of the conduit by substituting cable trays.

Figures 1 and 2 show these trays, which are built of galvanized expanded metal. They come in 8 ft lengths, and are simply bolted together on the job to form long channels. As Fig. 2 shows, they can be formed into both straight and winding channels, and can run vertically as well as horizontally.

Most of the trays are 18 in. wide, though they also come in 12 in. widths, They are 3 in. deep, and can be cut very easily with an air saw and fitted with elbows for making curved runs.

Once the trays have been installed, control and instrument wiring, many of them multi-conductor cables, are simply laid in the trays and routed to their various destinations.

The trays have two significant cost advantages over conduit. One is their considerable saving in material. For example, each unit in the original Contra Costa Plant required an average of 120,000 ft of conduit, whereas the use of only 2500 ft of trays on each additional unit cut conduit requirements to 26,000 ft per unit. The second principal advantage lies in installation costs, which are considerably less than the cost of installing conduit.

A further advantage of cable trays is their accessibility. Cables in trays can be inspected for the whole of their length, and locating a fault is easy. Replacements are simply laid in the trays alongside existing cables. This is a much quicker arrangement than having to locate a fault in a cable which is hidden in conduit, and then having to withdraw the damaged cable and pull in a new one.

That P.G. & E. engineers are well satisfied with the trays is indicated by their request that similar systems be installed in their Pittsburg, Calif., and Morro Bay Plants, both being designed and constructed by Bechtel Corp.

Fig. 1. Aerial view of Station 5A, latest unit in the program to control floodwaters of the Florida Everglades. Largest low-lift pump station in the world, its axial flow pumps take water from canal in foreground, discharge to channel in rear

Huge Pumps Control Florida Floodwaters

Six 116-inch diesel-driven horizontal axial flow pumps combine to make new Florida installation, midway between West Palm Beach and Lake Okeechobee, the largest self-powered pumping station

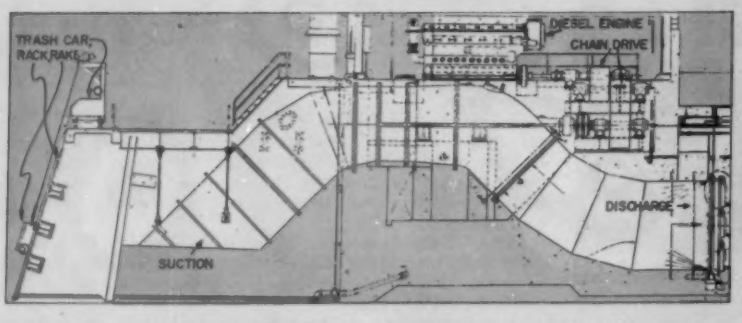


Fig. 2. Diagram shows arrangement of double-reduction chain drive to the pumps

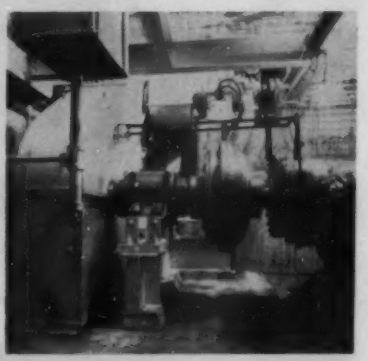


Fig. 4. This view shows the chain drive with flexible couplings and thrust bearings. All bearings are water cooled

Fig. 3. These six 1600-hp opposed-piston diesel engines drive big axial flow pumps through double-reduction chain drives; combined capacity is 2,160,000 gpm

Fig. 5. Close-up view of one of the six 116-inch pumps. Man at right shows size

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Power Engineering handbook

Soldering Electronic Connections

By STANLEY BEIDA *

Part 1. Selecting Solders and Fluxes

SOLDER IS ONE of nature's phenomena. Lead (melting point 620 F) and tin (melting point 450 F) combine to form solders with melting points lower than either. An alloy of 60 per cent tin and 40 per cent lead, for example, melts at about 370 F. Such lead-tin solders, called "soft" solders, are used extensively in soldering electronics connections.

Solders containing from 19.5 to 97 per cent tin *begin* melting at 362 F, hence this is the maximum operating temperature for joints so connected whether they are under stress or not. The chart in Fig. 1 shows the solid, plastic and liquid phases of the possible combinations of tin and lead, which explains the limitations. The "wetting" effect of solder (its ability to spread over a surface and adhere) is illustrated in Fig. 2. In this case, a purely arbitrary spreading index number of 100 is used to represent the properties of a 50–50 tin-lead alloy, and other alloys are shown in direct relationship to that number.

Figure 1 shows a sharp reduction of the distance between the "solid" and the "liquid" lines as the mixture approaches 63 per cent tin and 37 per cent lead from either direction. This ratio comprises the "eutectic alloy," and its melting point is about 358 F. Nearly all commercial solders are considered non-eutectic alloys. The most common are (tin-lead) 40–60, 50–50, and 60–40 — the latter being used for military and high-speed soldering.

Another factor entering the selection of solders is the required strength of the joint. Figure 3 compares the impact and joint (tensile and shear) strengths of the various alloys of tin and lead. It is generally unwise to have load-bearing joints or connections in electronic wiring, and the figures given in Fig. 3 bear this out.

Tin-lead mixtures are not used to solder aluminum and its alloys, since this mixture is corrosive. Replacing the lead with zinc produces a good aluminum solder. The solder containing 50 to 75 per cent tin and the balance zinc proves best, while the 60–40 tin-zinc alloy is most common.

Liquid solders or cold solders are not actually solders, but are cements or glues. As such, it is unreasonable to expect them to function as solders and therefore — no matter what the advertisements say — should *never* be used where soldering is required, especially on electronics wiring. Paste alloy solders, on the other hand, are finely powdered solders in a paste flux. Whereas these can be made to work, it is easy to use too much and may cause "cold joints" or "rosin joints" if the flux is not entirely boiled out of the joint.

*Electronics engineer, Designers for Industry, Inc., Cleveland, Ohio

fold along this line—outside edges toward you

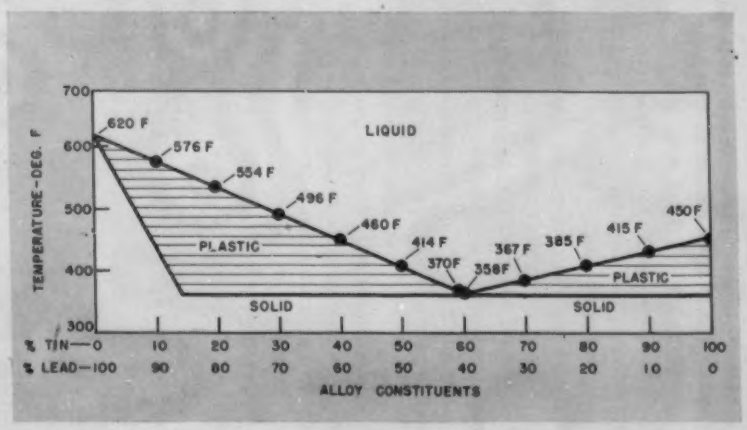


Fig. 1

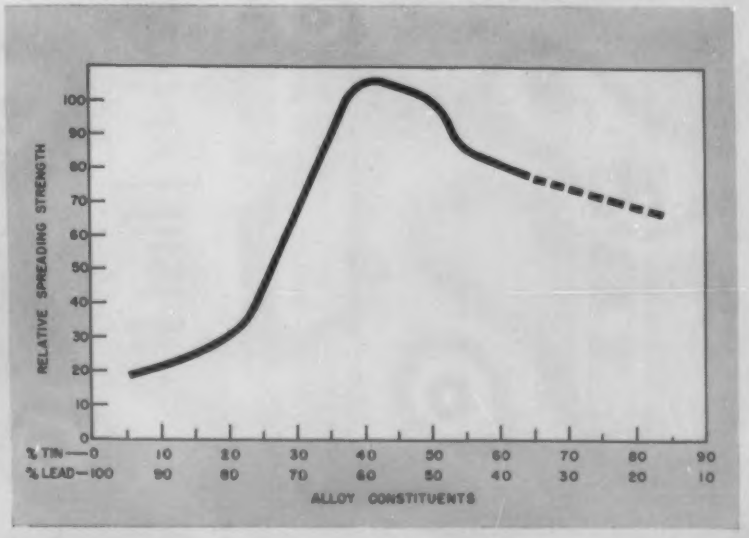
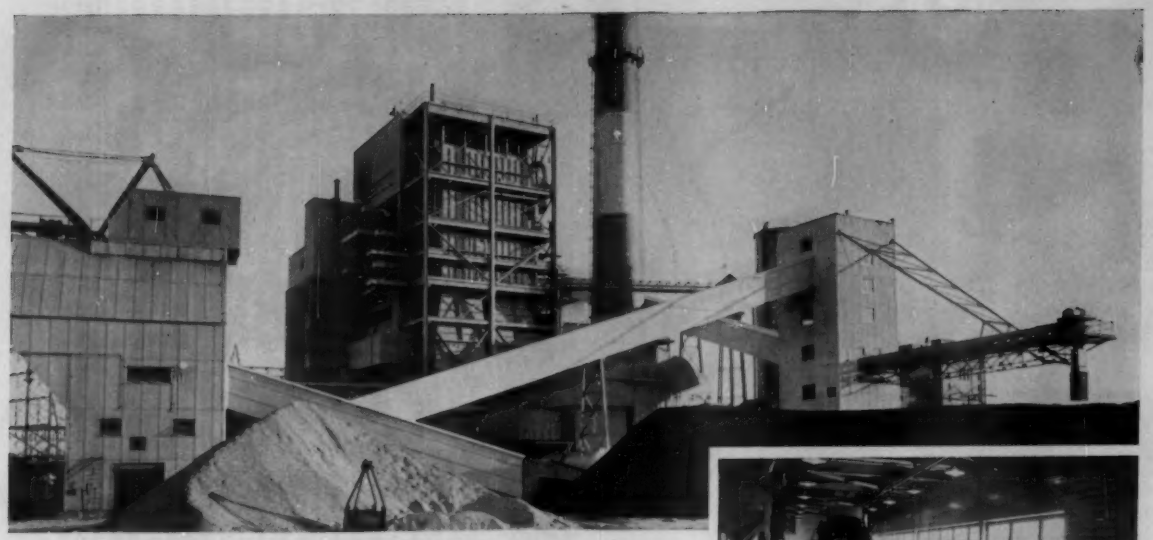


Fig. 2



Coal enters conveyor system at far left and moves to crusher house before going on to bunkers or to outdoor storage.

Traveling belt tripper over bunker discharges through Zipper bunker seal. Dust cannot escape since bunker is open only under discharge chutes.

Dockside to Bunkers

...This Coal Handling System is Engineered to Eliminate Emergencies

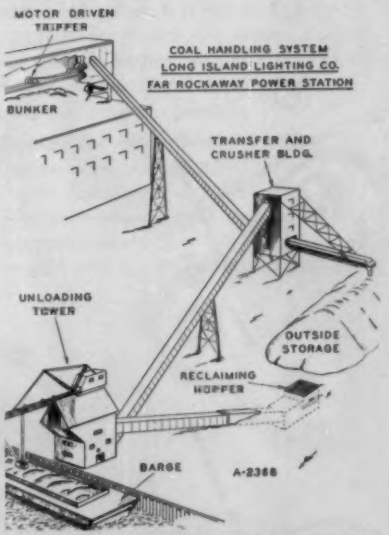
At the *Long Island Lighting Company's* new generating station at Far Rockaway, every facility has been planned to make sure that no forseeable emergency will interfere with power production. This includes the coal handling system engineered by Stephens-Adamson.

The complete system takes coal from dockside, crushes it, carries it to bunkers or stocks out for later reclaiming. It puts coal where it is needed—when it is needed—with a minimum of supervision.

In such an extensive system, skillful engineering plans to eliminate emergencies so that coal will keep moving without slow-ups or jam-ups. Thus, before coal ever enters the crusher, magnetic separators remove any tramp iron. Coal is weighed "on the run" as it travels on the 300 TPH belt conveyor to the crusher. After crushing, coal moves to bunkers or is shunted on an 80-ft. boom conveyor to storage. Coal going to bunkers is discharged through zipper seals that open and close like a slide fastener to prevent escape of dust.

To make certain that belt reversal cannot endanger or shut down the system, inclined conveyors are protected by S-A "no-roll" Hold-Backs on the head shafts. S-A spring type Belt Cleaners keep belt clean to prolong dependable service life. S-A "Pacific" belt conveyor carriers insure easy lubrication and long uninterrupted service.

In all details, this S-A coal handling system has been engineered to provide a continuous flow of coal with minimum maintenance, supervision or replacement. It is a good example of the thorough S-A engineering available to you. Write for a free survey and recommendations on a system to meet your needs for low cost coal handling for any conditions, any volume.



Sketch shows complete coal handling system at Long Island Lighting Company's new Far Rockaway Steam Electric Station. Conveyor system handles 300-tons per hour in 36-inch belts.

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Nearly all metals pick up (form) a film of oxide on their surfaces in time. Proper soldering requires that this be removed to permit the solder to contact the metal directly. Fluxes are used to do this cleaning for us, and also to prevent the formation of additional oxides while the metal is heated.

Fluxes are usually identified as corrosive or non-corrosive because this is the most critical distinction between them. The corrosive type includes muriatic acid, zinc chloride (killed spirits), and ammonium chloride (sal-ammoniac). These fluxes are usually available as a paste. *Corrosive fluxes must never be used in electronics work.*

Non-corrosive fluxes are made on a rosin base, and are logically called rosin fluxes. Available as a powder, paste, liquid, or stick, the rosin fluxes are ideally suited to electronics work and do not corrode the conductors. Furthermore, they form non-conducting residues (at least, they are *poor* conductors) and have little tendency to collect dirt or moisture. So-called "non-acid" or "neutral" fluxes are not necessarily non-corrosive, nor are all fluxes advertised as non-corrosive properly described. Remember that the *residue* of the flux must be non-corrosive, and that rosin-based fluxes meet this need.

Cored solders contain the flux in the center, but many times it is more convenient to apply the flux separately. Rosin may be dissolved in alcohol, for example, and leave no harmful residue. When core wire solder is used, the user can specify the rosin content as a per cent of the solder weight in ranges (i.e., 1 to 3 per cent, 3 to 6 per cent, 6 to 12 per cent, etc.).

Techniques used in applying these solders and fluxes to joints and then checking for faulty joints are given in the following section.

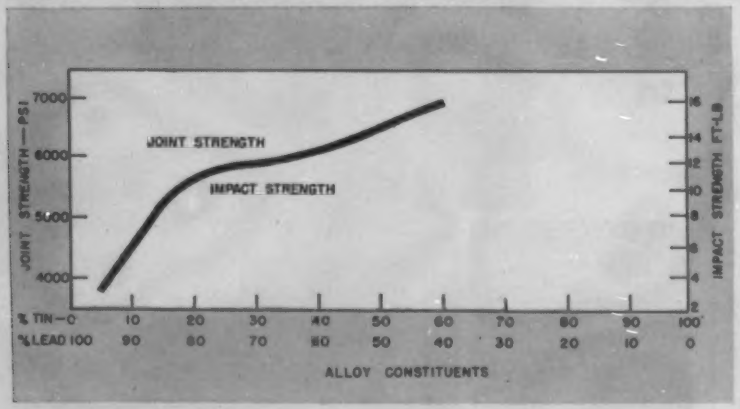

Fig. 3

Part 2. Making and Checking Solder Joints

GROWING complexity of modern electronic equipment makes it very difficult to locate faulty connections, and much time can be wasted in such a search. It is, therefore, increasingly important to make good soldered joints the first time.

The basic steps to proper soldering are: (a) Preparing the iron; (b) Preparing the joint; (c) Heating the joint; (d) Applying the solder; (e) Removing the iron; and (f) Checking the joint.

While this may seem unnecessarily detailed, such a feeling usually precedes a botched-up job. Check yourself on all these steps on the chance that you are now doing one of them incorrectly.

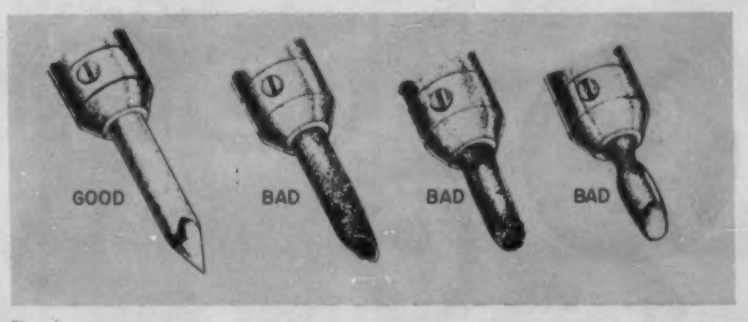

Fig. 4

Preparing the iron: Soldering irons should be as large as the working space permits since the heat capacity of the iron is a function of size. The tip shape (Fig. 4) should provide smooth, flat sides which can be "tinned" with a layer of solder and which can be wiped clean periodically on a pad or a wiping cloth. A dirty or poorly-tinned iron will probably produce "cold," "rosin" or "excessive solder" joints (Figs. 11, 12 and 13).

Preparing the joints: Remember that an electrical connection is not intended to be a load-bearing joint, but merely an electrical path. Support the connections mechanically before soldering and wrap the wire around the terminal as shown in Fig. 5 so that any tension on the wire will be transmitted to the terminal.

Wipe joints clean before soldering, scraping or sanding them lightly if extremely dirty. Even then a thin oxide film might be on the surfaces, but the rosin in the solder core will usually remove this. If the oxide film is suspected of being too heavy, a preliminary treatment with a separate flux is required. A non-corrosive flux paste or rosin in alcohol may be used. Do not over-flux. Paste fluxes should not be wiped on, but put on the end of a piece of wire and held against the heated joint. Allow enough flux to melt to cover the joint, but do not let it run down to the insulation. Excessive flux spreading to the insulation can cause breakdowns of the insulation and possibly break down the conductor as well.

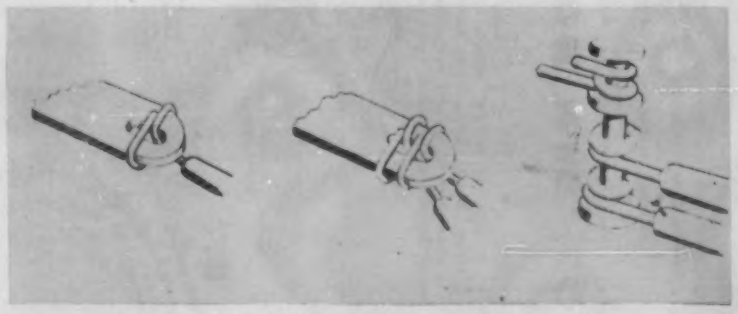

Fig. 5

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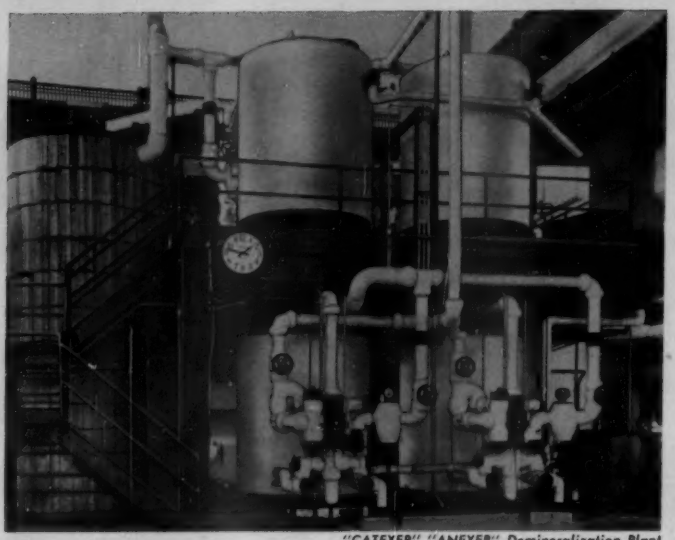

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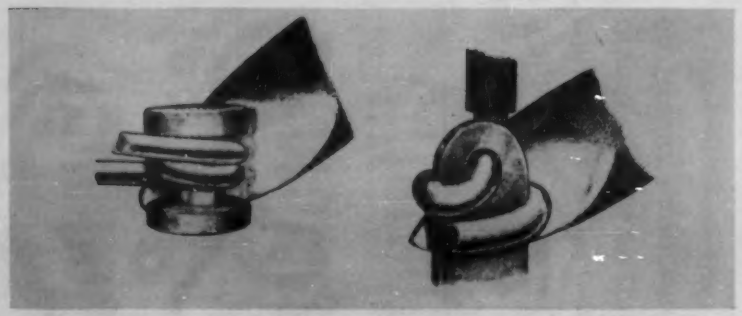


Fig. 6

Fig. 7

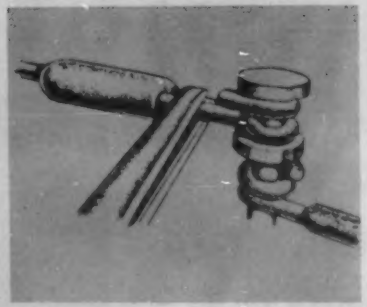


Fig. 8

Heating the joint: All parts of the joint should be heated as rapidly as possible. Hold the iron so that the tip contacts as much of the wire wrap and terminal as possible (see Fig. 6). Some solder should be between the tip and the terminal (Fig. 7) to produce a larger area of contact. Touch the area between the tip and terminal with solder to produce this surface, but do not use this solder to form the joint.

When heat-critical parts are near the joint, they may be protected from conducted heat by gripping the connecting leads with pliers or special clips. This provides a "heat sink" for excess heat flowing away from the joint and sidetracks it (See Fig. 8). Thermostatically controlled irons help avoid over-heating, but are no guarantee. Damage to surrounding parts and insulation and interference with fluxing action can still result from holding an iron to a terminal too long. Practice alone can determine the proper time.

Applying the solder: Solder should always be applied to the joint, never to the iron, and preferably on the opposite side of the joint from the iron. If the joint is too hot, the solder will sputter excessively and a black residue will form. If the joint is too cold, the solder will not melt instantly on contact. In either case, withold the solder until the joint reaches the proper temperature.

Figure 9 illustrates the proper technique for applying solder to a joint. Again note that solder should not be applied to the iron, since this will decompose the rosin before it has a chance to clean oxides from the critical surfaces. When flux-core solder melts, it first spreads its flux over the joint and the solder follows behind. As the solder

Fig. 9

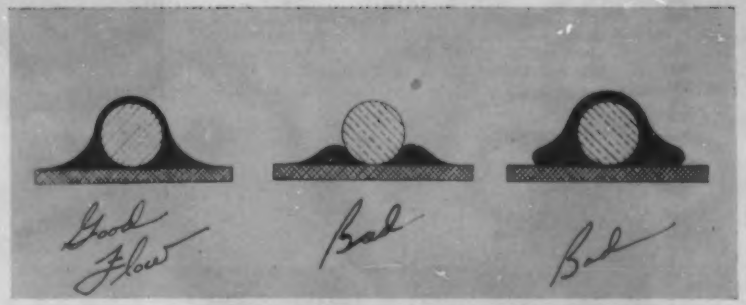


Fig. 10

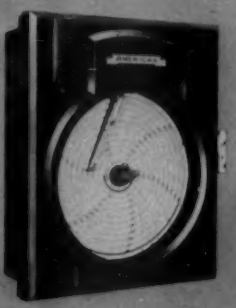
"wets" the surface, it forces the flux to the surface where it cannot weaken the bond between solder and metal. If the iron is removed too soon, some of the flux may be trapped in the solder to form a rosin joint (see Fig. 11).

Do not apply more solder than is required to "wet" the terminal and wire (Fig. 17). The optimum amount of solder has been applied when the gap between the wire wrap and the terminal is filled, but which still leaves the distinct outline of the wrap. More solder is unnecessary and it also makes it very difficult to locate defective joints if the circuit is faulty. Figure 13 is a typical excess-solder joint, which may or may not be a good joint in other respects. Who could tell?

Removing the iron: Always remove the iron as soon as it becomes evident that solder has properly bonded the joint.

Fig. 11

DIAL THERMOMETERS



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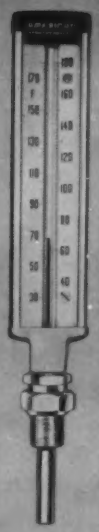

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Allow the solder to cool without disturbing the joint or a loose, high-resistance connection can result (Fig. 14). It is also important to avoid reheating joints after soldering because solder will oxidize in many such cases. Strength and "wetting" qualities of solder are very poor on being reheated, and this can occur whether correcting a bad joint or merely adding connections to the same terminal. For this reason, it is important to make all connections to a single terminal in a single operation (See Fig. 5).

Checking the joint: After the soldering operations are completed, check to be sure that solder has not spattered into areas where it can cause shorts and be sure that rosin (especially in the liquid state) has not spattered into areas where it can cause corrosion. Such residues should be brushed out of the chassis (or area) to prevent faulty operation.

Properly-made joints are shown in Fig. 17, but even when joints appear as shown here they should be checked for charred insulation. It is a little late at this stage to check for excessive removal of insulation, but if detected it should be corrected by cutting out the wire and replacing it with new wire and new solder joints. Insulation should not be more than about ¼-in. from the terminal but tape should not be used to "patch it up." In some cases it will be possible to draw the insulation over the wire closer to the terminal, in which case the wire need not be cut out.

Recognizing specific troubles with soldered joints can be expedited by referring to the illustrations (Figs. 11 through 16). To correct these conditions, remove the old solder and start from the beginning. Not shown, but equally important, is the visual check for charred insulation; do not reject the work when insulation is merely discolored by heat, but *do* reject and rework joints with charred insulation on connecting wires.

Finally, clip off extra length of wire ends (to within 1/16-in. of terminals) to prevent crossovers and shorts. This should be done when the joint is first wrapped, but whenever it is done be sure that the clipped wire-end does not fall into the chassis. Sharp diagonal cutting pliers (dikes) should be used.

NOTE: Handbook reprints are now available. See page 84 for details and prices.

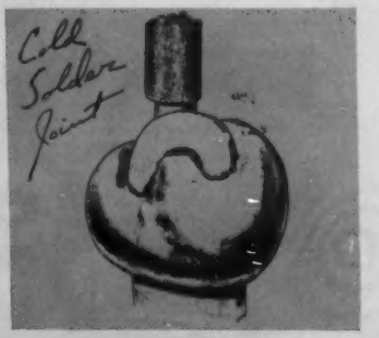


Fig. 12

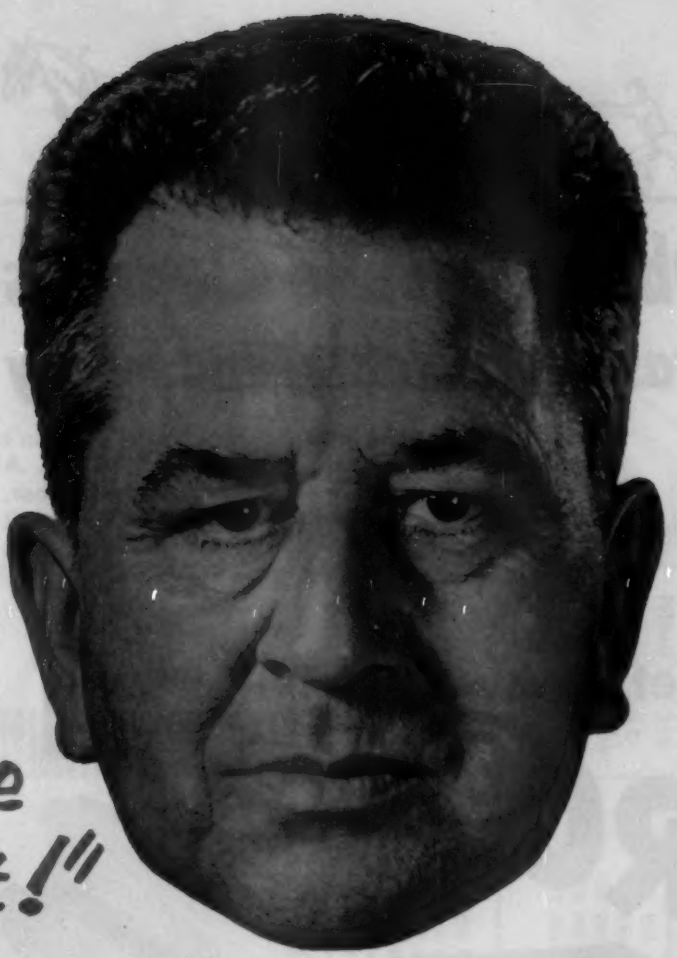
Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17



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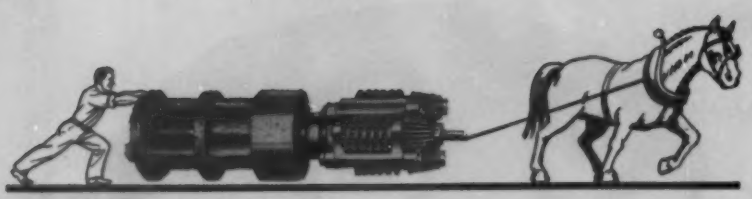

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Distribution for Domestic Loads

By H. E. LOKAY *

THE PEOPLE OF AMERICA today are experiencing more and more the benefits of electrified living. Their new appliances are not all labor saving; a substantial number are strictly for comfort and entertainment. As a result of this electrified living the domestic loads of utility companies throughout the country have doubled since the War and some have tripled.

The average annual kilowatt-hour use per customer in 1940 was 952, and has increased to 2540 in 1954. Following this same trend until the year 1985 the annual average use would be in the order of 7000 to 8000 kilowatt-hours.

Future distribution systems for residential areas will not be fundamentally different than the present distribution system. Substations will be larger, primary and subtransmission voltages will be higher and secondaries will be shorter in length.

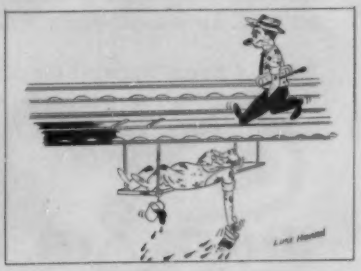
Present secondary systems at 120/240 volts with No. 2 secondary conductors are adequate for serving future loads up to approximately 9.5 kw per consumer, or about 7.5 times present load densities. Higher secondary voltage systems may prove economical in new residential areas if safety and public acceptance of higher voltage appliances can be obtained. It is questionable in existing areas due to the high transition cost. The single-phase system will prove to be more economical than the three-phase system if over-all costs of the consumer and utility are considered.

Banked secondary systems will gain greatest favor in serving growing residential loads as most effective use of system components can be obtained.

Increased use will be found of "low cost underground systems" in new better than average residential areas.

Minimum costs can be obtained by the distribution engineer with intelligent and organized system planning and better understanding of the thermal capacity and emergency ratings of various system components.

*Electric Utility Engineer, Westinghouse Electric Corp. This is a brief abstract of a paper delivered before American Power Conference, March 31, 1955. Complete paper will be in Proceedings.



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VALVES, TRAPS, PIPING AND ACCESSORIES

201 **Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

202 **Lubricated Plug Valves** — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

203 **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

204 **Blow-Off Valves** — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

205 **For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

206 **Valve Chart** — Form 194, 24 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

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207 **Choosing the Right Valve** — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in

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non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. Crane Co.

208 **Steel Gate Valves** — Five types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 B, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

209 **General Service Valves** — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

210 **Industrial Valves** — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

212 **Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

214 **Steam Trap Solutions** — Bulletin F.151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives pointers on installing and servicing traps. The V. D. Anderson Co.

215 **Unions and Fittings** — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

216 **Welded Fittings** — Catalog 3 is a 36-pp ordering and engineering reference book on company's Weldolets for piping services. Gives data on butt-welding and socket welding Weldolets as well as on Thredolets for making threaded outlets. Typical installations are pictured; sizes, weights and prices provided. Also included are installation instructions and a technical section. Bonney Forge & Tool Works.

217 **Forged Steel Unions** — Bulletin U-1 describes company's forged steel unions, listing dimensions in sizes ⅛ to 2 in. in 3000 lb class. Design features which make the unions desirable for high pressure service and for resistance to shock, vibration and misalignment stresses are fully described. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

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PACKINGS, GASKETS, SEALS

219 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

220 O-Rings for Sealing, Gasketing — Catalog AD-148, 20 pp, describes company's O-rings for sealing and static gasketing. Gives design information, recommended pressures, and available materials for both dynamic and static applications. Also lists standard O-ring sizes. The Garlock Packing Co.

PUMPS, PUMPING

221 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

222 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

223 For Abusive Pumping Jobs — Catalog 4906, 36 pp, covers centrifugal pumps for wide, industrial use and especially adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a horizontal shaft, single-stage side suction pump; a horizontal shaft, single-stage, rear-entrance automatic priming pump; vertical shaft pumps with standard, overhead and quill bearings for wet pit applications. Nagle Pumps.

225 On Vertical Pumps — This 16-pp bulletin describes and illustrates application of vertical industrial service pumps for liquid transfer from short settings in both industrial and process services. Points out advantages and describes three basic designs. Stresses versatility of the pumps due to design flexibility. Also gives general recommendations for obtaining optimum performance, and includes photos of typical installations. Peerless Pump Div., Food Machinery and Chemical Corp.

FUEL OILS, LUBRICANTS

226 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

227 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.).

228 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The special requirements of porous bearings are also discussed. The Texas Co.

229 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils also safety precautions. Cities Service Petroleum, Inc.

230 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metal working operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

231 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

BOILERS, GENERATORS

232 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

233 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

235 Standard Boilers — Eight-pp Bulletin WT-8 describes company's "S" series of boilers with capacities ranging from 10,800 to 50,000 lb. Lists data and specifications on each of the models and sizes and discusses general design features and special "S" type construction features. Wm. Bros Boiler & Mfg. Co.

236 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

237 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such advantages as three-pass design, forced draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

238 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

TUBING AND ACCESSORIES

240 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Gives details on proper installation. Scovill Mfg. Co.

241 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

243 Nickel Pipe and Tubes — Bulletin T-17 is a 28-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

244 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described. Thomas C. Wilson, Inc.

245 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

WATER CONDITIONING

246 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800-B compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to

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use 2-bed, 3-bed, 4-bed, mixed or mono-bed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

247 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

248 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

249 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers the limitations of hot process softening. Infilco Inc.

250 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

Postage-free cards for ordering these catalogs are provided on pages 117–118

251 Chemical Control and Testing — The need for intelligent chemical control and testing to assure the success of a water conditioning program is described in this 6-pp pocket-sized folder. Emphasizes need for explicit control limits and chemical tests to show that these limits are being met. Hall Laboratories, Inc.

252 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

253 Testing Equipment — Designed for use as a guide in the selection of water testing equipment, this 12-pp bulletin de-

scribes complete line of titration stands and test sets for hardness, alkalinity, chloride, sulfide, etc.; cabinets and test sets for similar tests; Conducto bridge for determination of specific conductance of water solutions. W. H. & L. D. Betz.

254 Demineralizers — Valuable information on demineralization is offered power engineers in comprehensive 24-pp Bulletin WC-111. Discusses demineralization in general and its advantages and applications. Basic types of demineralizers and their special uses are charted. Resins, piping, valves and accessory equipment are treated in detail. Book also provides flow charts showing demineralization systems fo chemical plants and power plants. Graver Water Conditioning Co.

255 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

256 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

INSTRUMENTS AND CONTROLS

257 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

258 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater automatically. Copes-Vulcan Div., Continental Foundry & Machine Co.

259 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are given, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

260 For Feedwater Analysis — Bulletin 148BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

261 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered

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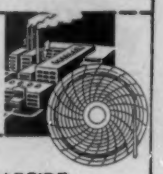

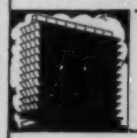

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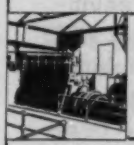

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by this gage, explains operation. The Reliance Gauge Column Co.

262 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

264 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

ELECTRICAL EQUIPMENT

265 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

266 Electric Motors — Twenty types of company's motors are illustrated in 8-pp Bulletin 1878. Illustrated in natural color, the bulletin contains descriptions of Uni-closed, totally-enclosed, explosion-proof, Varidrive, Syncrogear, combination variable speed and internally geared units, right-angle worm gear, and other types. U. S. Electrical Motors Inc.

267 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, and a practical method of obtaining insulation temperature. James G. Biddle Co.

268 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

269 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

270 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution prac-

tices in large and small plants. Covers utility distribution practices: methods of buying electric power: what to do when a choice of primary voltages is available: application of primary switches and circuit breakers: types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

COAL, ASH HANDLING

271 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

272 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

273 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

274 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

275 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

INSULATION

277 Insulating Material — Ultrafine, a thermal and acoustical insulation made of blown glass fibers, is presented in this bulletin. Shows it in use; gives data on properties, thermal conductivity. Gustin-Bacon Mfg. Co.

278 Pipe Insulation — Mono-Kover, a lightweight one-piece pipe insulation, is described in this bulletin. Photos show how easily it is applied, and text covers its thermal resistance, permanence, resiliency, non-corrosive properties and lower applied cost. Also included are a thermal efficiency chart, insulation thickness selection table. Baldwin-Hill Co.

REFRACTORIES

279 Refractory Concrete — Basic information on recommended practice for

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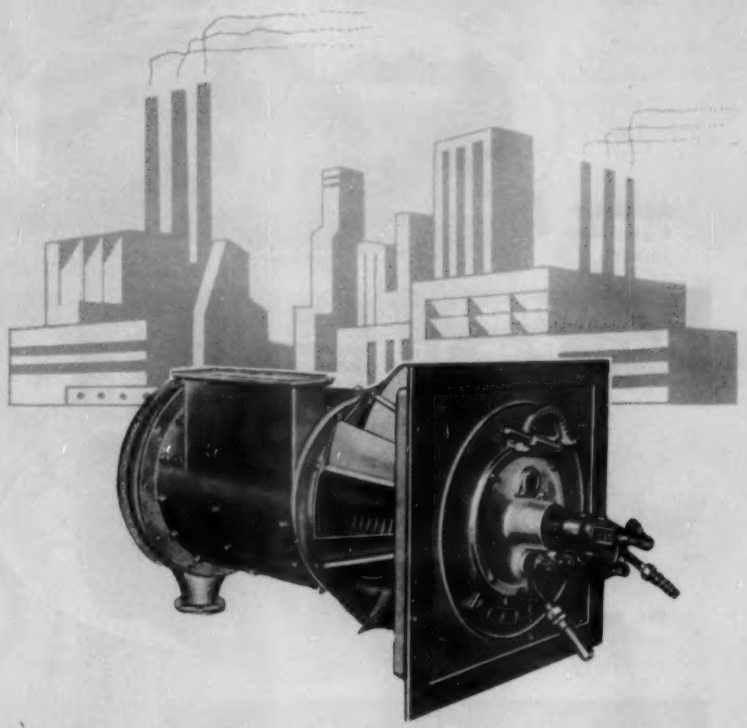

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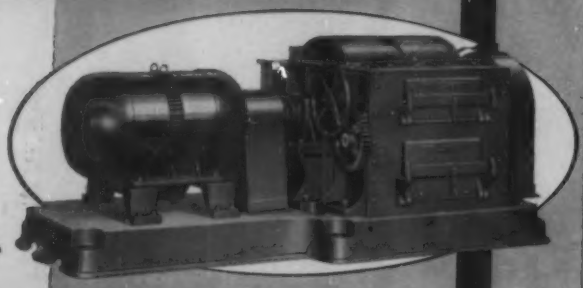

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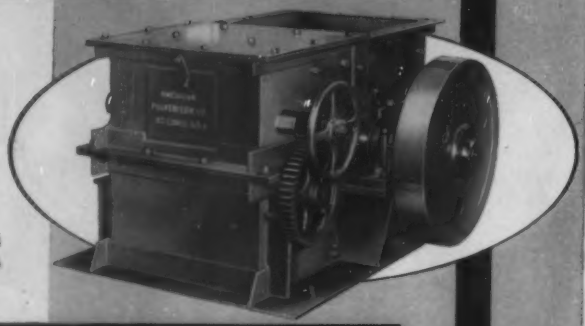

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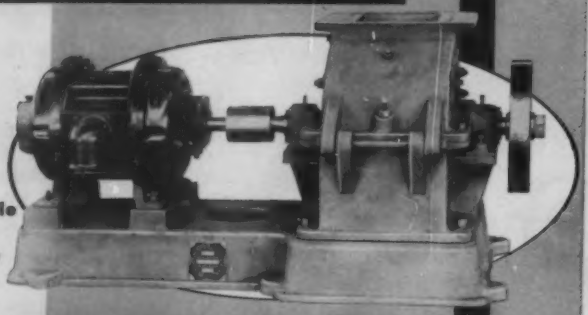

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mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

280 Refractories for Heat, Power — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for repairs. Norton Co.

281 Refractory Notes — Included in Vol. XV of this company's Thermogram is an illustrated article on a method for degreasing hot topping costs in steel mills with minimum capital expenditure. Another story tells how bonded brick assemblies cut installation time in a coke plant. Refractory & Insulation Corp.

BURNERS

282 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

283 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

OTHER EQUIPMENT

284 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

285 Steam Accumulator — How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

286 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

288 Turbine Speed Control — Thirty-pp wire-wound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

289 Steam Condensers — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment to steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

290 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

291 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for condensers. Henry Vogt Machine Co.

292 Chemical Cleaning — Technical information on how preventive maintenance cuts replacement costs is contained in this pamphlet which describes how dirty and clogged filter beds were restored to operating efficiency through chemical cleaning. Describes company's preventive maintenance program. Dowell Inc.

293 Good Operating Practices — Some 101 good suggestions for maintaining plant buildings and equipment are presented in the 12-pp new edition of this booklet. Well illustrated, contains latest recommendations for getting the best service out of insulations, packings, refractory products, roofings and friction materials. Johns-Manville.

294 Conveyor Belt Chart — Engineering data for standard conveyor belt constructions is given in this chart and accompanying sheet. Strength characteristics of eight popular ply and material combinations of conveyor belt constructions are provided. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

295 Dust Collection — Aerodyne dust collectors in chemical processing and other industries are discussed in 8-pp Bulletin 171. Explains theory and design of collector system, includes drawings of the various types covered. The Green Fuel Economizer Co., Inc.

296 Tubing Support System — Twelve-pp Bulletin 254 presents a system for permanent and continuous support of instrument tubing. All items and fittings are illustrated by photo or dimensional drawing. Details of actual installations show some of the methods by which this system can be quickly and economically erected at the job site. Instrof Inc.

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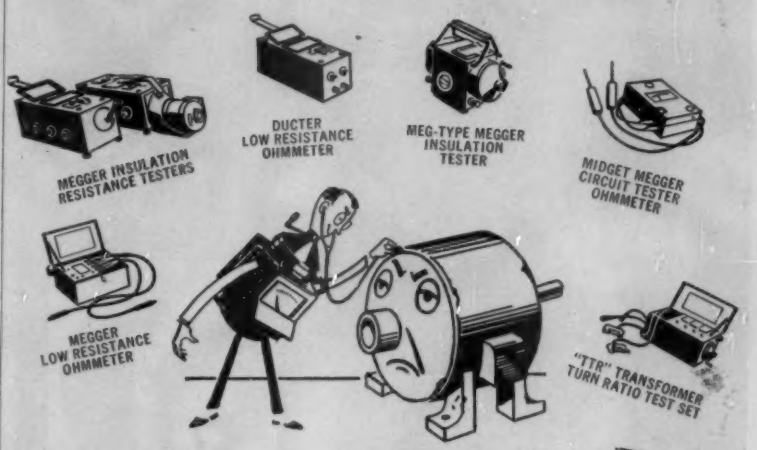
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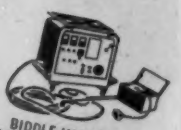

It includes the following bulletins written by practical electrical men for your understanding and guidance. If you don't have File "21" up to date, we invite your request. File 21 will be mailed promptly at no obligation.

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- ☐ **Bulletin 21P9**—"Maintenance of Industrial Electrical Equipment"
- ☐ **Bulletin 21P10**—"Cut Electrical Breakdowns"
- ☐ **Bulletin 21P11**—"Getting the Most From Insulation Resistance Measurements"
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- ☐ **Bulletin 21P16**—"Motor Maintenance with a Check Chart for Alternating- and Direct-Current Motors"

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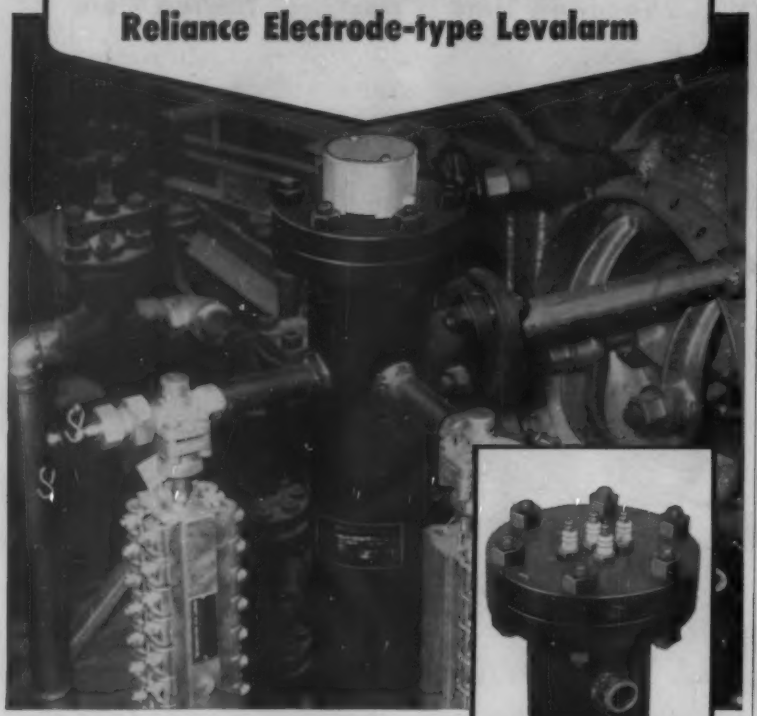
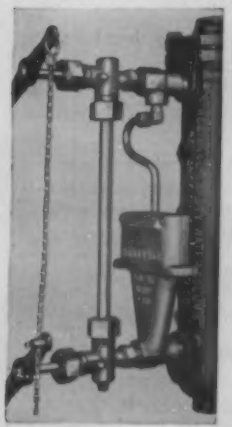


Cap removed showing electrode connection fittings

Boiler water connects own alarm system and fuel cut-out . . .



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Lower photograph — Fuel cut-out Levalarm on low pressure water column.

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HELPFUL BULLETINS

continued from page 32

159 Modern Filtration — The sintered metal filter as a more efficient tool for industry is presented in this 16-pp illustrated booklet. Discusses advantages of company's Filterall unit with sintered metal elements, and includes details of head selection and construction. Permanent Filter Corp.

160 Operation Rehabilitation — Eight-pp Bulletin 55 covers scientific methods of machinery inspection and new methods of industrial equipment repairs. Text and photos present company's coordinated program of inspection, analysis of equipment failure, and restoration services. Maintenance Engineering Corp.

161 J.I.C. Hydraulic Standards — This 20-pp revised compilation of the J.I.C. Hydraulic Standards for industrial equipment presents the "standards" in complete form. Also included are the Recommended Practices on hydraulic packings and seals, examples of packing code identification, sample circuit using J.I.C. symbols, glossary of terms and other useful information. Miller Fluid Power Co.

162 Ductile Iron — Bulletin DI-25, 30-pp, describes an increasingly popular constructional material — ductile iron — the engineers' link between the useful properties of cast iron and steel. Tells how this cast metal combines the process advantages of cast iron, such as castability and machinability, with the strength, toughness, wear resistance and ductility of steel. Illustrated with more than 40 photos, bulletin includes case histories, specification tables for the seven main types of ductile irons and charts on properties. The International Nickel Co., Inc.

163 American Water Power — "Water Over the Dam," 24 pp, traces the development of our water power from colonial days to emergence of the electric power era half a century ago. Beginning with a reference to a grist mill in Nova Scotia around 1605, this well illustrated booklet highlights water power developments from that period until the early twentieth century. Allis-Chalmers Mfg. Co.

164 Draftless Air Diffusers — Selection Manual 50, 64-pp, contains over 100 illustrations showing installations, design and use of aspirating air diffusers and accessories. Serves as a guidebook to aspirating air diffusers for all purposes, and includes a special section on high velocity units. Presents information on selection of proper air diffuser for any purpose or type of installation, including considerations of the sound levels of air diffusers. Along with illustrations of air diffusers, manual offers tables and charts giving data on design and performance. Anemostat Corp. of America.

166 On Hydrant Selection — Manual 54-5, a 16-pp catalog of non-freezing ground and wall-type hydrants, is designed to help power engineers select the correct hydrant for every type of installation. Pictured and described are wall installations, post and box type and encased hydrants. Contains hose and pipe sizes, engineering drawings, roughing-in dimensional data. J. A. Zurn Mfg. Co.

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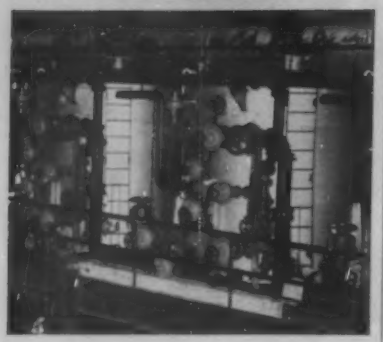

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NEW ENGINEERING BOOKS

Mechanical Refresher for Professional Engineers License by John D. Constance, P.E. Size 10⅞" by 8⅛". First edition, 1954; private printing. Published by John D. Constance, 625 Hudson Terrace, Cliffside Park, N. J. Price $3.00.

This book has a specific objective . . . to help candidates pass the examination for professional engineer's license in the various states.

It concentrates on the subject matter of the examination, and the stated intention of the book is to enable the busy man to avoid the time and trouble of wading through large numbers of textbooks both during preparation and while taking the examination.

The contents originally appeared in a combined text written primarily as lecture notes used by the author in a series of refresher courses sponsored by the ASME in New York City for the State of New York examinations. However, it has now been expanded and completely rewritten, and is now suitable for wider use in all the other states.

Although the essential theory is only summarized, the book contains a large number of solved problems taken from past examinations so that the student may become familiar with the type of problem he will encounter in the examination.

In addition to its use as a professional engineer's examination study aid, the book can also be used as a reference manual for Civil Service examinations for engineers, power engineers' examinations, as a general refresher for all engineers, and as a problem book by engineering instructors.

The author has been active over the past ten years helping engineers obtain licenses through the use of books such as these and the use of his guidance procedures, and readers of POWER ENGINEERING will no doubt be familiar with the several articles he has published on the same subject in the last few years.

* * *

Introduction to Servomechanisms, by A. Porter. 1st edition; 154 pages, 4½ x 6¾ in.; cloth. Published by John Wiley & Sons, Inc., 330 West 42nd St., New York, N. Y. Price $1.75.

This little book is one of a series of monographs, intended to supply readers of average scientific attainment with a compact statement of the modern position of each subject. This particular book is based on a course of lectures given at the Military College of Science at Shrivenham, England, to army officers and students taking engineering physics as one of their main subjects in the second year of the technical staff officers' course. It is not intended for the student who wishes to specialize in the theory and design of automatic control systems and servomechanisms, but rather for the physicist, the physiologist and engineer who is merely interested in the subject. The object of the book is two-fold. First, to answer the question so often asked in recent years, "What is a servomechanism?" And second, to indicate in terms of elementary examples, the theoretical foundations of the subject with particular emphasis on the basic problems of servo design, namely, those of insuring adequate damping and small dynamic lags.

This is a very interesting small volume and well worth the attention of any engineer even remotely interested in the subject of servomechanisms. The author is head of the Research Department, Ferranti Electric, Ltd., at Toronto, Canada, and formerly Professor of Instrument Technology at the Military College of Science at Shrivenham.

* * *

Matter Energy Mechanics by Dr. Jakob Mandelker. 1st edition; 73 pages, 6 x 9 in., cloth. Published by The Philosophical Library, 15 E. 40th St., New York, N. Y., 1954. Price $3.75

This book on Matter Energy Mechanics is based on the energy concept of matter —MC^3. It unifies and extends relativity mechanics by introducing a new kinetic energy formula. This new formula follows from the fact that the motion of a body whose mass increases with velocity is equivalent to motion with resistance. As a conse-

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quence, the work performed is not as commonly supposed equal to the kinetic energy but must always be greater. The book readjusts our concept with regard to the motion of a body moving at speeds approaching the velocity of light.

Matter Energy Mechanics is an extension of the mechanics originated from the relativity theory and in no way violates the existing concepts of that theory; rather, it enhances those concepts and harmonizes many aspects concerning them which heretofore gave rise to many inconsistencies.

The author is Associate Professor of Mechanics at the George Institute of Technology at Atlanta.

The book of necessity, is quite mathematical in its treatment of the subject, but most of it should be understandable to those who have had an ordinary engineering education.

★ ★ ★

Elements of Structural Engineering, by Ernest C. Harris. Size 9 by 5¾; 505 pages including index and appended tables. Published by The Ronald Press Co., 15 East 26th St., New York 10, N. Y. Price $7.00.

It seems to us that the title of this excellent new work, although sufficiently descriptive of its contents, fails to convey adequately the essential purpose of the book — that purpose being to provide the non-civil engineer with a sound reference text which will give him the necessary information he might need for the design of simple structures in timber, steel, or concrete. This book was not written for the civil engineering student; it contains no treatises on the construction of skyscrapers, hydroelectric plants, dams, or superhighways. It does, however, explain and describe structural theory and practice that might be of interest to the mechanical, electrical, or hydraulic engineer contemplating the design and construction in his plant of a conveyor, a catwalk, or a temporary bridge over an open ditch.

The author, formerly a structural and consulting engineer in industry and government, now professor and chairman of the Department of Civil Engineering and Engineering Mechanics at Fenn College, is a well-qualified authority; his text has been prepared throughout with a thorough insight into the ordinary problems of the non-civil engineer who occasionally may need help in working out a design in structure. Diagrams are plentiful and help to supplement and clarify the textual material.

Among the subjects covered are: equilibrium and reactions; shear, thrust, and bending moment; analysis of trusses and bracing; analysis with moving loads; deflections in beams; design in steel members and their connections; design in concrete and timber. Tables are furnished giving the properties and dimensions of rolled steel sections, rivets, screw threads, reinforcing bars, lumber, and nails. Other tables are provided for determining loading stresses, soil-bearing pressures, and weight of building materials.

This book is highly recommended to the power engineer as a useful reference work to aid him in undertaking those structural projects that come up from time to time but which are not so extensive as to warrant consideration of the services of consulting engineers.

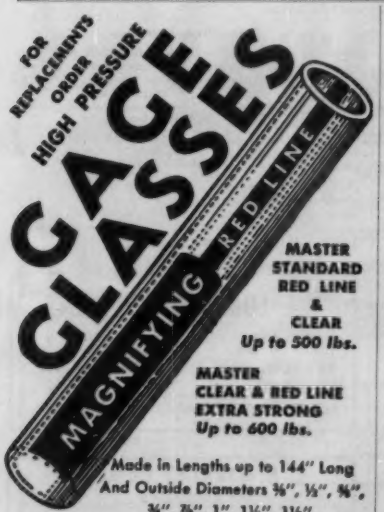
★ ★ ★

Das Wärmetechnische Messwesen in Dampfkraftwerken und Industriebetrieben (Thermal Measuring Techniques in Steam Power Stations and Industrial Plants), by A. Ketnath, First Edition. Size 6½ by 9½ in., 222 pages including index. Published by Springer-Verlag, Reichpietschufer 20, Berlin W35 (West Berlin), Germany. American agent: Stechert-Harner, Inc. 31 East 10th St., New York 3, N. Y. Price DM 25, 50 ($6.00 app.)

This book is interesting, primarily because it is complete, not because it contains anything new. There is a large faction in our engineering society which will find it impressive because it is in a foreign language. Again, we emphasize that its chief value lies in its exhaustive treatment of a subject with which most of us are relatively familiar.

The book is divided into three parts: Part I Heat Measuring and Measuring Apparatus; Part II Layout of Control Apparatus; Part III Layout of Heat Control Installations.

Part I consists of a treatise on measuring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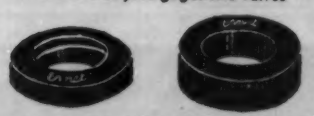

FIG. 21—Lip Mold FIG. 22—Standard

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Part III concludes the book with a discussion of control system layouts and the layout of control boards or panels.

★ ★ ★

Ultra High Frequency Engineering by Thomas L. Martin, Jr. 1st edition; 456 pages, 5½ x 8½ in.; cloth. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y.

This book comprises a general study of the techniques associated with ultra high frequency systems. It deals with the theory and technique of the component parts that make up complete systems but not with the functioning of such systems as a whole. The book provides a firm fundamental background in the general subject of ultra high frequency engineering to qualify the reader for such new fields of electronic engineering as radar, facsimile, television, blind-landing systems for aircraft, ionosphere measurements, pulse-time modulation, telemetering, and electronic computing.

Six general classifications of subject material are discussed in this book. These are as follows:

1. Generation and synchronization of special wave forms.
2. Amplification for UHF systems.
3. UHF transmission systems.
4. UHF circuit elements.
5. UHF oscillators.
6. Propagation of signals.

Mathematics through calculus is assumed, as well as the usual introductory courses in electron tubes and circuits. Differential equations, both partial and total, are used in the text but all steps involving their use have been carried through completely and accompanied by considerable verbal explanation.

Thomas L. Martin, Jr., who wrote this book, is Assistant Professor of Electrical Engineering at the University of Mexico.

★ ★ ★

Standards and Typical Specifications for Deaerators and Deaerating Heaters, Heat Exchange Institute. Third edition; 11 pages, 8½ x 11 inches; paper backed. Published by the Heat Exchange Institute, 122 E. 42nd St., New York 17, N. Y. 1954. Price $1.00, plus 20¢ on foreign orders.

This book is a revision of the previous document on deaerators and deaerating heaters first published by the Institute in 1940 and then revised in 1945. Data carried over from the previous issues have been

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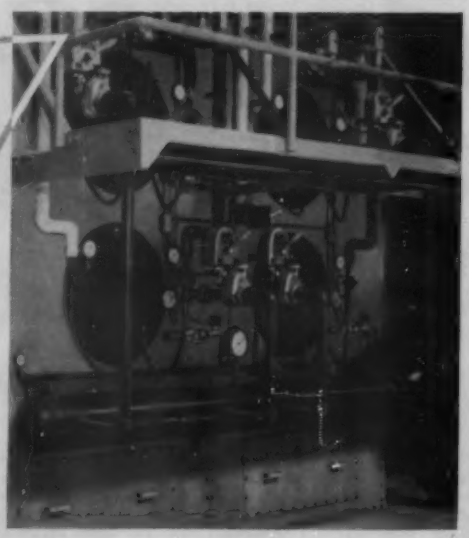

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rearranged and brought up to date, and a new table has been added giving storage and minutes and cubic feet for tabulated capacity from 10,000 pounds per hour to 1,600,000 pounds per hour. Tables of shell and head thicknesses have been revised and expanded, as has the table on accessories collection and standard opening sizes. The book contains the chart showing flow through valves at pounds per hour and tables giving temperature, pressure conversion from 140 F to 212 F, and pressure temperature conversion from 0 to 125 psig. New diagrams show typical arrangements of deaerating heaters. Typical specifications have been revised and brought up to date.

The object of this treatise is to help the purchaser of deaerators and deaerating heaters by defining terms and establishing standards of capacity performance and construction, material which is rather difficult to obtain elsewhere.

* * *

How to Attract and Hold Engineering Talent (Executive Research Survey Number Three); 60 pages, size 6 by 9 in., paper binding. Prepared by The Professional Engineers Conference Board For Industry, 1121 Fifteenth St., Northwest, Washington 5, D. C., in cooperation with the National Society of Professional Engineers. Single copies $2.00.

This little booklet reads very much like a memo written by an executive to himself. It contains little that an intelligent administrator would not figure out in the normal course of investigating his engineering turnover problem, but the very existence of the present heavy turnover indicates that once conceived, these thoughts are promptly forgotten or pigeonholed. It is true that engineering talent is changing hands (or employers) much too often.

One of the main problems seems to be the naïveté of the young engineers and the willingness of prospective employers to take advantage of it. Too often, the recruiting line of a company hard-pressed for engineers resembles that of a young swain dabbling with a summer romance. He makes no limit to his claims, since he thinks that he will never have to live up to them. Unfortunately, the employer that succeeds in recruiting the inexperienced engineer this way finds that he is in much the same spot as the young swain whose summer romance followed him home from the resort. The following relationship is seldom satisfactory. Of course, the recruiting agent has made his mark by getting the men; what happens next is someone else's responsibility.

While salary is distinctly a problem, such primitive recruiting practices often make it necessary to pay more than would otherwise be necessary to guarantee satisfaction of the engineering staff.

These problems are discussed with varying degrees of thoroughness in the book. Others dealt with include: professional recognition of engineers by management; engineers' unions; vacation employment for engineering students; training programs conducted by or paid for by the companies; opportunities for advancement; causes of resentment; incentive programs; security; merit rating; variety of job assignments.

It would appear that management's long preoccupation with labor problems in the factory has left it wide open for the development of problems in its creative branches. We cannot agree entirely with the unspoken but implied opinion in the survey that the problems discussed are new. We *do* believe that they exist, and that most of them have existed for a lot longer than they thought. After all, what has been said that should surprise an alert management? That engineers want an opportunity to expand themselves? That they want security (of a mature sort)? That young engineers don't want to be sold a bill of goods that doesn't exist?

The critical nature of the engineering procurement and retainment problem has developed only after engineers found themselves in a market which allowed them to seek that which they could reasonably be expected to want. The fact that they often want more than they can possibly get, or that they do not know exactly what they *do* want, shouldn't change the picture because that is human nature with truly historic precedent.

So we can recommend the booklet for your reading; not because it holds something new, but because it tells that which alert management should have known for a lot longer than evidence indicates it has.

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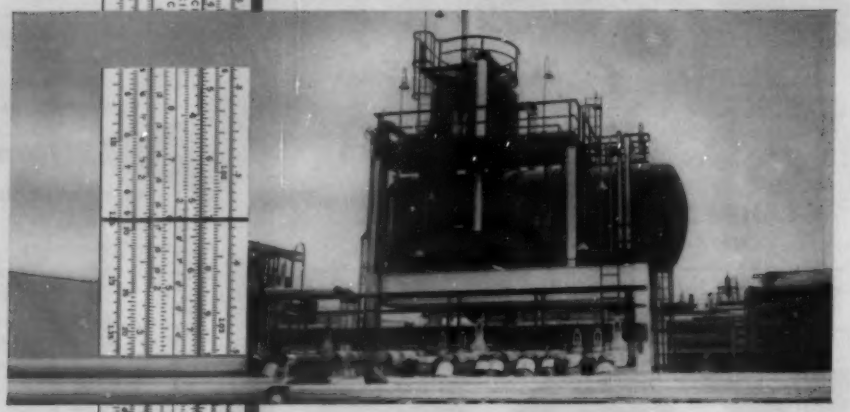

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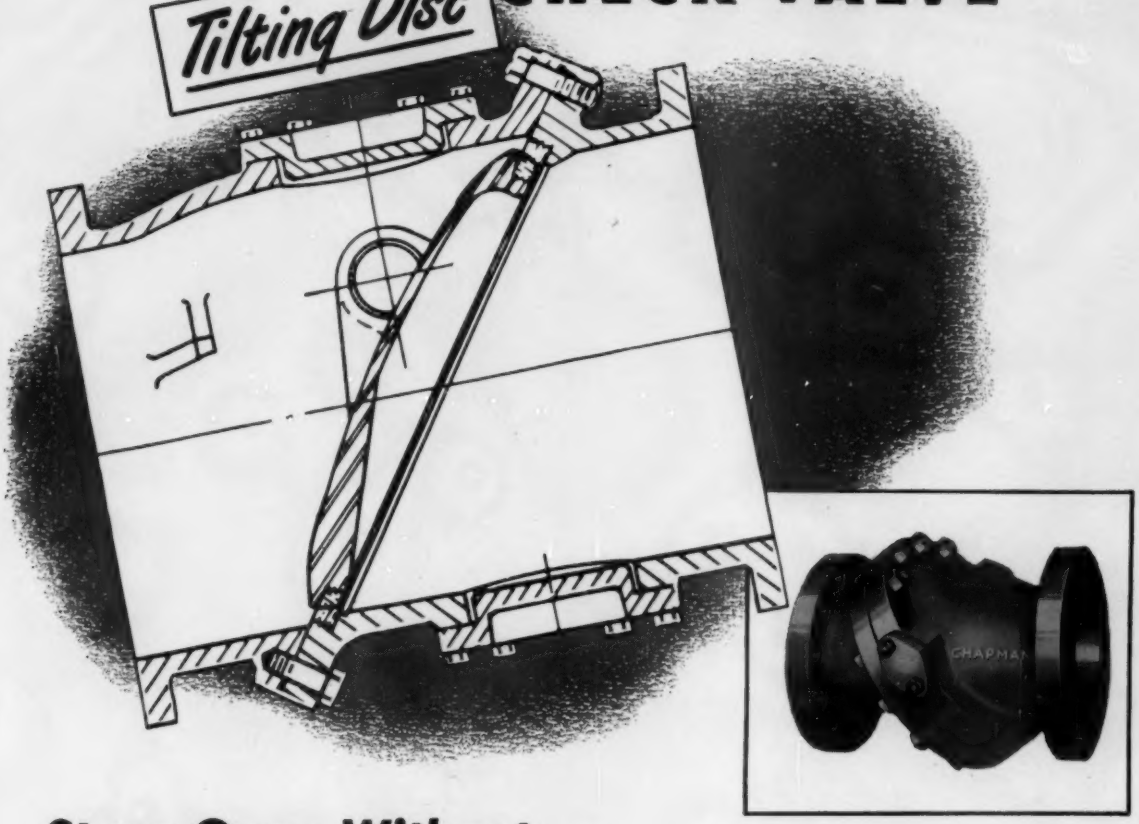

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